FOOD SAFETY KNOWLEDGE AND ATTITUDES OF FOOD HANDLERS IN HOSPITALS IN THE CAPRICORN DISTRICT MUNICIPALITY IN LIMPOPO PROVINCE, SOUTH AFRICA

By

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DECLARATION

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Title of a thesis: Food safety knowledge and attitudes of food handlers in hospitals in the Capricorn District Municipality in Limpopo Province, South Africa

I declare that the above thesis is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that I have not previously submitted this work, or part of it, for any degree or examination in any other higher education institution.

SIGNATURE: _____ **DATE:** December 2017

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DEDICATION

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ABSTRACT

The purpose of this research was to investigate the level of food safety knowledge, attitudes and food handling practices of employees in hospitals in the Capricorn District Municipality (CDM), Limpopo Province, South Africa. Purposeful sampling was followed to sample 210 respondents from nine hospitals in CDM. Respondents were individuals who are 18 years or more, employed in these hospitals and are involved in the food handling duties. Data collection was done by means of questionnaires and interviews. The results showed that 99% and 70% of the food handlers are black females and are health care staffs. Up to 71% have not attended any food safety-training course. Many food handlers are not knowledgeable about HACCP and the correct temperature and duration for receiving and storing temperature controlled for safety (TCS) foods respectively. The vast majority of food handlers are not knowledgeable on minimum internal cooking temperature for poultry, seafood, egg and the best way of thawing of frozen meat. The majority of food handlers do not know that *Salmonella* is the main foodborne bacteria pathogen mostly associated with poultry products and that food borne bacteria will grow quickly in food at a temperature of 37 ˚C. The majority of food handlers possess adequate food safety knowledge regarding the safe food handling practices and the prevention of contamination. Respondents with higher academic qualifications do not possess more food safety knowledge than those with lower academic qualifications. Food handlers who are health care staff have less food safety knowledge when compared to food service managers, food service supervisors and chefs.

Keywords: Food; safety; knowledge; attitude; handling practices; food service employees; hospitals

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
CCP	Critical Control Points
CDC	Centre for Disease Control
CDM	Capricorn District Municipality
CHE	Council of Higher education
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FIFO	First In First Out
FSMA	Food Safety Modernization Act
HACCP	Hazard Analysis and Critical Control Point
KAP	Knowledge, Attitudes and Practices
NACMCF	National Advisory Committee on Microbiological Criteria for Foods
PCT	Partial Cross Tabulation
PHF	Potentially hazardous Foods
SPSS	Statistical Package for the Social Science
TCS	Temperature Controlled for Safety
WHO	World Health Organization

1. CHAPTER 1: BACKGROUND

1.1. Introduction

The cooking and storage of food at incorrect temperatures and the cross-contamination of food due to unhygienic handling practices are regarded as the main causes of many foodborne disease outbreaks in food preparation and service facilities (Baluka, et al., 2015). Factors such as poor personal hygiene and the procurement of food from unreliable sources have been found to contribute to foodborne disease outbreaks in food preparation and service facilities (Sani & Siow, 2014). The possession of inadequate food safety knowledge by food handlers poses a serious threat to food safety in food preparation and service establishments such as hospitals (Ifeadike, et al., 2014). The food safety knowledge, attitudes and practices (KAP) of food handlers have always been a cause for concern over the years due to high incidences of foodborne disease outbreaks (Sufen, et al., 2014). The possession of inadequate food safety knowledge by food hanlders can translate in low level of food safety consciousness during during the handling of food (Ahmed, et al., 2017). Therfore, all food handlers are required to possess adequate food safety knowledge and skill to handle food hygienically during preparation and serving of to ensure that food is safe by the time it reaches the consumer (Ifeadike, et al., 2014).

Food handlers are required to avoid the contamination of food by microbes by maintaining high standards of food hygiene and sanitation at all times (Lambrechts, et al., 2014). However, even if food handlers do possess the skills and knowledge to handle food safely, human handling errors and inadequate equipment and resources in food service facilities can facilitate the contamination of food (Sani, 2013). Many hospitals in South Africa contain food service units that are responsible for preparing meals and serving meals to patients in hospital wards.

An outbreak of foodborne disease outbreaks in such establishments can lead to service disruption, life threatening diseases and even death for anyone who is infected, especially the already vulnerable patients (Lund & O'Brien, 2011). The unique aspect of the food service facility in a hospital is that it involves the procurement of raw food materials and the preparation of meals destined for hospitalised people. There are always challenges in the application of appropriate food safety control measures to guarantee food safety in these food service facilities (Lahou, et al., 2013). Any outbreak of foodborne disease in the food preparation facilities of hospitals can have more serious consequences for patients because most food-poisoning which can be self-limiting in healthy individuals, can be deadly for debilitated patients whose immune systems are very weak (Lund & O'Brien, 2011; Wallace, et al., 2013). Very little information is available on food safety knowledge, attitudes and food handling practices of food service employees in hospitals in the Capricorn District, hence the purpose of this study, therefore, is to investigate factors that influence the food safety knowledge, attitudes and food handling practices of food service employees in hospitals in the Capricorn District Municipality in Polokwane, Limpopo Province, South Africa.

1.2. The research problem

Problems relating to the safety of food prepared in the food preparation facilities of in hospitals range from inadequate food safety knowledge and practices of food handlers to the non-implementation of HACCP principles. The lack of adequate food safety knowledge and skill by food hnadlers decrease the level of food safety consciousness during food preparation (Ahmed, et al., 2017). Similar, a negative food safety attitude has been associate to poor hygiene practices. Food handlers who were found to know the importance of using caps, masks, protective gloves and adequate clothing were also found not to be adhering to safe food practice

related to these items (da Cunha, 2014). Food handlers, with no or limited training about food hygiene practices, can contribute to the spread of foodborne diseases as a result of malpractices during the flow of food in food service establishments (Sharif, et al., 2013). Foods can be contaminated with foodborne pathogens by direct contact with food handlers with poor personal hygiene, especially if they have diarrhoea (Margar, 2014). Food handlers should attend proper training on personal hygiene in order to improve their food safety practices (Jeewon, et al., 2017; Todd, 2016; Gizaw, et al., 2014; Gaungoo and Jeewon, 2013).

Some hospitals' food service units do not have food safety procedures such as HACCP that are required to ensure the production of safe and quality foods (Taylor, 2015). Furthermore, in cases where the HACCP system does exist, some food handlers are not well trained on how to implement the HACCP programme (Garayoa, 2014). The successful implementation of a HACCP plan is facilitated by commitment from top management who are sometimes not well trained in the implementation of HACCP procedures (Lahou, 2015). Lack of infrastructure, improper sanitation practices and poor food hygiene knowledge can lead to foodborne disease outbreaks (Kibret and Abera, 2012). If the problems relating to ensuring food safety in food service establishments are not properly addressed, foodborne disease outbreaks which cause morbidity and mortality in the general population as well as economic cost due to hospitalization will be inevitable (Sudershan, et al., 2014). When there is a foodborne disease outbreak, the government incurs costs by funding health institutions to deal with the problem (Scharff, 2012; Hussain, 2013). Food service units can suffer from lawsuits if people hospitalized in healthcare institutions get foodborne diseases (Madhu, 2015; Busby, 2012).

1.3. Motivation for the study

1) The importance of this research for hospitals in the Capricorn District

Traditionally, food in rural hospital settings has not enjoyed a good reputation for many reasons, including, amongst others, the safety of food served in these institutions. The Capricorn District Municipality (CDM) cannot fail to respond to allegations that it has not always enjoyed good reputation on food safety matters, since it has hospitals in rural settings and sub-urban areas. In order to guarantee the safety of food in hospitals a lot of questions need to be answered. Some of the questions raised over the years concerned the food safety knowledge of hospital employees, their food safety attitudes and/or behaviours, and their food handling practices. Nosocomial infections, including foodborne disease outbreaks, often take place in institutional health care settings, especially hospitals and old-age homes, and they can lead to very serious health care consequences for both patients and people visiting these patients in these health care institutions (Costa, et al., 2017). The foodborne disease outbreaks can pose adverse significant financial burdens on society and health care systems in the country. Training and educating health care workers on food hygiene is essential in order to reduce foodborne related diseases. Several studies have been conducted in various food service industries. However, fewer studies have been carried out in public health institutions in order to take an in-depth look on these food safety variables – knowledge, attitudes and handling practices. These variables affect food safety and nutritional care of the hospitalized patients and other patronage who depend largely on hospital food services either during their stay in hospital or while visiting one. When health care workers do not pay enough attention to food hygiene in hospitals, this may pose very serious problems, particularly given the presence of patients, who, due to their compromised immune systems, could be more vulnerable than healthy people to microbiological and nutritional risks (Lazarević, et al., 2013). Lazarević, et al. (2013), further elaborates that in nosocomial outbreaks of foodborne disease, the mortality risk has been proved to be significantly higher than the community outbreaks and highest for foodborne outbreaks in most rural setting where there is a lack of resources and infrastructure.

On the other hand, the common involvement in the role of food handlers, not specifically trained about food hygiene and hazard analysis critical control points (HACCP), may represent a significant cause of concern in health care institutions.

2) How this research will contribute to solving the problems as highlighted in the problem statement

The findings of this study will assist hospital authorities in the Capricorn District Municipality (CDM) to develop policies and standards relating to food safety operating systems. Furthermore, the findings of this study will encourage managers to instil a culture of compliance amongst all employees involved in food handling. The findings of this study may also assist in revising the current standard operating procedures (SOP's) in food service units in hospitals in the Capricorn District Municipality (CDM).

1.4. The aim and objectives of the study

1.4.1 Aim

The aim of this study is to investigate the food safety knowledge and attitudes of food service employees in hospitals in the Capricorn District Municipality, Limpopo Province, South Africa.

1.4.2 Objectives

This study will:

- Evaluate the food safety knowledge of food handlers in hospitals.
- Investigate food safety attitudes of food handlers in hospitals.

1.5. Research questions

- Do the food service staff in public health institutions, such as hospitals, have adequate food safety knowledge, positive attitudes and/or behaviour, and training on matters relating to food handling practices?
- Do food service workers in public health institutions adhere to the HACCP protocols?

1.6. Layout of the Dissertation

This study has six chapters, which are arranged as follows:

Chapter 1 Introduction: This first chapter is the introduction to the study; it provides an overview of the study and provides background material. This section also outlines the problem statement, the purpose of the study, the aim and objectives of this study and explains the layout of the dissertation.

Chapter 2 Literature review: The literature review in Chapter Two (2) provides an overview of current and existing literature on HACCP. It deals with barriers to food safety implementation. It describes food safety knowledge, food safety attitudes, food handling practices, food hygiene and food safety measures in hospitals. It also documents food – borne disease outbreaks in South Africa; and Microbial food safety in hospitals.

Chapter 3: Methodology**:** This chapter outlines the research area, data collections and the research instruments that were used. The limitations to the research are briefly discussed.

Chapter 4: Results: The chapter outlines the research findings emanating from the research survey in various participating hospitals from the respondents.

Chapter 5: Discussion: This chapter provides a comprehensive discussion of the results on the socio-demographic information of respondents, food safety knowledge, attitudes and food

handling practices of respondents. Further discussion on results of analysis of variance (ANOVA) was also provided in this chapter.

Chapter 6: Conclusions: In this chapter, conclusions and recommendations for improvements are provided. A list of references and appendices then follows.

1.7. Research Conceptual Framework

Different variables and factors can influence food safety in food service facilities. Inadequate food safety knowledge, negative food safety attitudes, and poor food hygiene practices of food handlers can have a negative effect on food safety in a food service facility. For example, people without knowledge, or those who have a negative attitude tend to do things incorrectly (Dejaeghere and Hooghe, 2012). Inadequate food safety knowledge leads to poor practices in food handling. Poor hygiene practices can cause food borne illnesses as contended by Ismail, Chik, Muhammad and Yusoff (2016). Improper implementation, failure to follow procedures and lack of training on HACCP programmes may compromise food safety in food service units. HACCP provides food service businesses with a cost effective system for the control of food safety. It deals not only with the ingredients, production, storage and distribution of food, but its sale and the service rendered to the final consumer (Di Renzo, et al., 2015). Lapses in food safety contribute to food contamination and that leads to foodborne disease outbreaks which cause morbidity and mortality in the general population as well as economic cost due to hospitalization of the affected population (Sudershan, et al. 2014). When there is a foodborne disease outbreak, the government incurs costs by funding health institutions to deal with the problem (Scharff, 2012; Hussain, 2013). Food service units can suffer from lawsuits if people who are hospitalized in healthcare institutions get foodborne diseases (Busby, 2012).

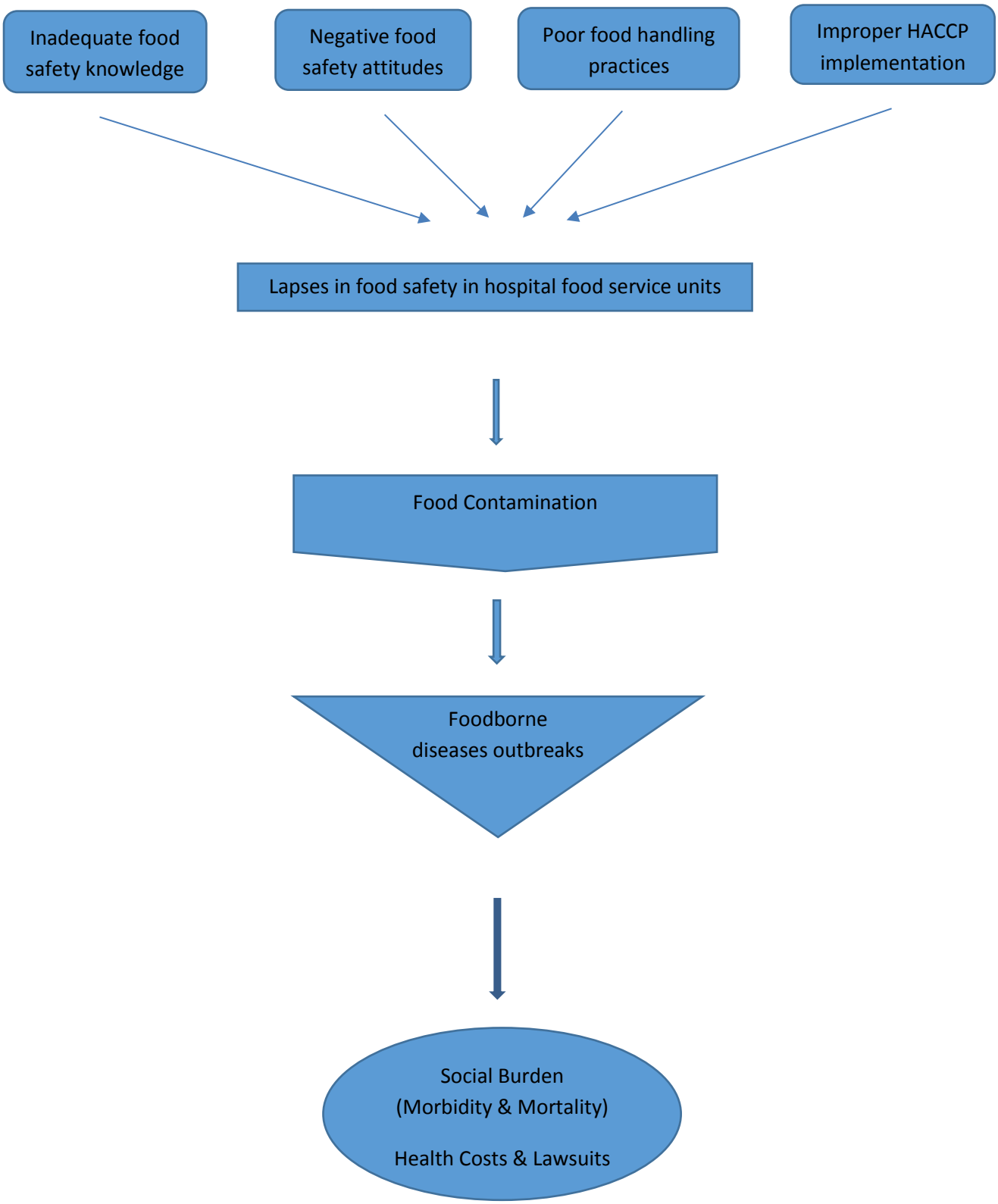

Diagram 1 A Conceptual framework showing the variables that affects food safety in food service facilities.

2. CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

Food safety continues to be one of the most significant issues in the food service industry, especially in developing countries, South Africa included. It is said that the full burden of foodborne disease in developing countries is not known but experts believe that developing countries bear the brunt of most foodborne diseases. This is assumed as a result of the high number of cases which are often reported in developing countries. A high prevalence of potentially foodborne pathogens are often found in hospitals. Community surveys of children and adults with diarrhea indicate that a lack of clean water for washing food and utensils is common cause in developing countries. The use of human sewerage or animal sewerage for horticulture production is another factor related to diarrhea in developing countries, especially when people do not practice good personal hygiene like washing hands before eating.

The burden of foodborne diseases is difficult to estimate than the burden of single diseases such as malaria or tuberculosis which are prevalent in most African countries. The most common manifestation of foodborne disease is diarrhea, but most cases rarely or never get tested in a laboratory.

2.2. Hazard analysis critical control points (HACCP)

Food safety is critical to the success of food service establishments. The current methods such as controlling time and temperature, safe food handling procedures, cleaning and sanitizing techniques, implies that HACCP is not adequate. (Harris, et al., 2017; Harris, et al., 2015; Kang, et al., 2015). Food-safety hazards can be introduced into food production and service operations

in several ways, such as by food itself, equipment used during the processing of food, by food suppliers distributing food to various food service units and inappropriate handling of food by the customers themselves.

According to the FDA (2004) Food Code, the hazards may be biological (bacteria, viruses, parasites and fungi); chemical (cleaning chemicals, pesticides, and food additives); or physical (which is dirt, broken glass and crockery that accidentally gets into food). The Hazard Analysis and Critical Control Point (HACCP) system was updated and standardized in 1989 by the National Advisory Committee on Microbiological Criteria for Foods (NACMCF). The broad utility of HACCP was recognized by the NACMCF, although by nature of the committee the risk assessment portion was developed only for microbiological hazards. Recent extension of the NACMCF microbiological risk assessment procedures to potential chemical and physical hazard analysis was suggested by Corlett (2009). The combined hazard analysis for food hazards provides a powerful tool for food safety evaluation and planning guided by HACCP principles and the blueprint for direct application of the specific HACCP system for preventive food safety in a commercial manufacturing operation (Borràs, et al., 2015).

HACCP is not new. HACCP is mandatory in food service establishments according to the Republic of South Africa's regulations (SABS Food Hygiene Management Code 049 of 2001). Constable, et al. (2016) states that HACCP was first used in the 1960s by the Pillsbury Company to produce the safest and highest quality food possible for astronauts in the space programme. The National Academy of Sciences, National Advisory Committee for Microbiological Criteria for Foods, and the Codex Alimentarius have endorsed HACCP as the best process control system available today(Constable, et al., 2016). The World Health Organization (WHO, 2015), suggested that consumers can implement HACCP-like practices in the home by following proper storage, handling, cooking and cleaning procedures. The organization further suggested that from the time a consumer purchases meat or poultry from

grocery stores to the time they cook and serve a meal, there are many steps to ensure food safety (WHO, 2015). These practices can be accomplished through properly refrigerating both meat and poultry products, separating raw food from cooked food during storage and thoroughly cooking meat and poultry to a well-cooked stage in order to prevent bacterial growth in food. The FDA Food Safety Modernization Act (FSMA), the most sweeping reform of the food safety laws in more than 70 years, was signed into law by President Obama on January 4, 2011. The Food Safety Modernization Act aims to make sure that the food supply globally is safe by doing away with the notion of focussing on contamination, but to make sure that contamination is prevented throughout the supply chain (FDA, 2015).

2.3. Barriers to food safety implementation

The hazard analysis critical control (HACCP) system is a very important food safety mechanism that most developing and developed countries throughout the globe try to implement and make sure that it is adopted. Food service production plants which do not comply with the implementation of HACCP systems may face penalties. The food safety literature demonstrates that for a HACCP system to be useful and successful, it needs an excellent mix of managerial, organizational and technical skills (Ricci, et al., 2017). Some of the large food production companies still face difficulties in implementing the HACCP system even if they have better equipment, technical specialists and better management. This may be due to lack of training or due to lack of food safety management systems. These difficulties and/or barriers may vary from country to country. There are many difficulties and barriers to implementing food safety management systems. The knowledge level amongst food service managers and their subordinates, the unavailability of resources for the food service institution

and business and even the accessibility of government, may be cited as some of these factors. (Sozen & Hecter, 2013).

The main barriers to implementation of a HACCP system in food service units include the lack of proper knowledge on HACCP and the high cost of implementing a HACCP system. The food safety regulator needs to provide periodical training and consultation services for food safety management system (FSMS) applications in the food service industry, and the government should provide financial support the skills development levy (SDL) (Karamana, Cobanoglub, Tunalioglub, Ova, et al., 2012). A lack of prerequisite programmes has been mentioned as the key barrier identified for all food businesses (Cusato, et al., 2012); while lack of knowledge on HACCP principles, lack of time for its implementation, high labour turnover, low employee morale and/or lack of employee motivation, complicated terminology used in developing training manuals and poor or lack of personnel training, are the other most common contributing barriers to food safety implementation in food service units (Shariff, 2013).

Another survey by Macheka, et al. (2013), has revealed that the main barriers for the implementation of a food safety management system (FSMS) in Harare, Zimbabwe included lack of financial resources, the magnitude of the organisation, poor infrastructure and facilities, and a lack of commitment from top management (Macheka, et al., 2013). Not much research has been conducted to determine barriers which hinder the implementation of food safety practices in hospital food service units in the public sector. This research will attempt to identify barriers or problems relating to the implementation of food safety practices. In addition, it will determine, at district level, the demographic characteristics of employees to perceived barriers (Dzwolak, 2014).

2.4. Food Safety Knowledge

Food safety knowledge refers to the conditions and practices that preserve the quality of food in order to prevent contamination and foodborne illnesses amongst consumers (WHO, 2015). Food safety knowledge is important in food service units because food-borne disease outbreaks continue to occur globally, often intensified by the global trade that substantially impacts costs to individuals, the food industry and the economies in countries (Faour-Klinbeil, 2015). Most food handlers in hospitals display some knowledge about food hygiene and safety, as they know that the use of caps or head gear, mouth masks, hand protective gloves and general satisfactory body clothing reduces the risk of cross contamination. They are also aware that the washing of hands before handling food reduces the risks of contamination, and that taking care of personal hygiene ensures safe food for consumers, as it avoids cross contamination amongst food handlers and consumers (Robarts, 2017). Furthermore, it has been noted that knowledge about food safety and hygiene is significantly higher amongst food service employees who work in hospitals that have adopted the HACCP system (Abdelhafez, 2013).

A study conducted amongst food handlers in military hospitals in Michigan revealed that, in general, food handlers' knowledge is high. In their study, food handlers demonstrated knowledge in the categories of high risk foods, food borne diseases, food storage temperatures, and sources of food contamination (Sharif, et al., 2013).

In contrast, a study conducted on university food service workers to examine the relationship between their knowledge of food safety and their educational level, length of employment, and food safety training showed that food handlers often lack knowledge regarding hygiene, time-temperature control, cross contamination, and cleaning and sanitizing practices (Webb, et al., 2014). Furthermore, regardless of educational levels, the food safety performance of employees in the survey was less than satisfactory and that may be attributed to the fact that the researcher

did not link employee behaviour and attitude with food safety knowledge (Morancie, 2015). Literature at hand indicates that there is a vast differences in terms of level of food safety knowledge in various food service settings – either health, military or commercial institutions; but workers' knowledge in general is affected by factors such as education level, place of employment and ethnicity (McIntyre, Vallaster, Wilcott, Henderson & Kosasky, et al., 2013).

2.5. Food Safety Attitude

Azjen (1980) defines attitude as a measure of degree to which a person has either a favourable or unfavourable evaluation towards behaviour. For example, if a person thinks that preparing and handling food hygienically is important and necessary, he or she is likely to engage in positive behaviour. Food safety attitude may be defined as a predisposition or a tendency to respond positively or negatively towards food safety (Booth, et al., 2013). For example, a food handler who knows the importance of washing hands before working with food, but does not wash hands or a food handler who knows the importance of wearing protective clothing at work but does not wear it, exhibits a negative attitude (Quick, et al., 2013). Food safety attitude of food handlers is important in food service units because food handlers play an important role in ensuring food safety throughout the chain of storage, processing, production, preparation and retailing or serving of food to the public (Bismark, et al., 2014).

A positive attitude towards food safety should not only be seen as the responsibility of food service managers, but as a collective commitment for all those who work with food. Food handlers, amongst others, should use their own initiative to enhance their knowledge in the matter and positively try to promote food safety in the food service workplace (Gong, 2016).

A study conducted in Malaysia (in 2013) to investigate food handlers' beliefs and attitudes toward food safety and any perceived barriers towards safe food handling demonstrated that food handlers' attitudes have a positive effect on food safety behaviour and significantly improved their commitment to handling food safely (Aziz, 2013). Vladimirov (2011) points out that there is a correlation between positive behaviour, attitudes and continued education of food handlers and the maintenance of safe food handling practices. Results from studies evaluating food safety interventions (e.g. psychosocial and educational) on consumer behaviour have shown these interventions can be effective at eliciting food safety changes in terms of behavior, knowledge and attitudes (Nesbritt, et al., 2014). In most cases, food handlers have a tendency of OB in relation to the risk of being responsible for handling foods that can cause food borne diseases in patients. When food handlers participate in recurring training, they become more cautious about food safety measures. Food handlers who are over confident and unaware of the importance of safety rules, may overlook some protection procedures and, as a result, may contaminate the food, especially when they work under pressurized conditions (da Cunha, Braga, Passos, Stedefeldt, & Rosso, et al., 2015).

2.6. Food Handling Practices

Most food handlers in public health institutions do not have the basic training needed to work in a food preparation environment; therefore they may not know how to follow food safety instructions during food handling (Akabanda, et al., 2017; Kibret and Abera, 2012). According to the World Health Organization, food handlers are a major risk to food contamination in food preparation areas. Very dangerous organisms present in or on the food handler's body can multiply to infective doses, given the right conditions (which are commonly moisture, warm temperatures and darkness), and come into contact with food, or surfaces used to prepare food

(WHO, 2015). All food handlers should be encouraged to have a good knowledge of how the work they do can affect the safety of the food they handle. According to the Australian Food Safety Standard 3.2.2 (Food Safety Practices and General Requirements), food handlers must have the appropriate skills and knowledge in areas related to food safety (Al-Shabib, et al., 2016). Food handlers should be encouraged to apply the HACCP principles, which are to: conduct a hazard analysis, determine critical control points, establish critical limits, establish monitoring procedures, establish corrective actions, recordkeeping and documentation and verification procedures. The lack of knowledge may increase improper food safety work methods that will promote microbial hazards and subsequent food borne diseases (Ahmed, et al., 2017).

To date, food safety interventions are mainly based on training. Responses from food handlers indicate that training cannot be a stand-alone intervention method to address issues on food safety, but rather a multi-disciplinary approach is needed (Onyeneho and Hedberg, 2013). Food safety training interventions should be designed so as to address a wide range of factors that are related to food safety or that may compromise the success of food safety programmes. In one study conducted in Dangila Town food and drink establishments, on factors affecting food handling practices among food handlers, it was found that above half of the workers had good food handling practices; but marital status, monthly income, food safety knowledge status, existence of separate dressing rooms and the presence of insects and rodents were factors associated with food handling practices (Tessema, et al., 2014). In 2012, a nosocomial outbreak of diarrheal disease caused by extended-spectrum beta-lactamase-producing multidrug-resistant Salmonella *enterica serovar Typhymurium* was reported in a pediatric ward in South Africa (Suleyman, et al., 2016). The spread of this disease which peaked between May 2012 and July 2012 was attributed to person-to-person transmission due to a breakdown in hand-washing and hygiene, sup-optimal infection control practices, over-crowding of hospital wards,

and an undesirable nurse-to-patient ratio (Smith, et al., 2013). The current literature suggests that the training of food handlers with regard to safe food handling practices, should be carried out in multi-dimensional approaches covering social, environmental and organizational factors, and with greater focus on risk perception that leads to unsafe practices.

2.7. Food hygiene in hospitals

Previous research has indicated that poor food hygiene control in hospitals may result in serious consequences especially for vulnerable patients, whose immune systems are already at risk. These patients may be exposed to very serious infection and possible complications. When patients are infected with foodborne infections, they may start to refuse to eat meals provided by the hospital food service units, because they live in fear of being re-infected (Ssebatta, 2016). The mortality risk has been proved to be significantly higher than the community outbreaks and highest for foodborne outbreaks, nosocomial outbreaks of infectious diseases (Webb and Morancie, 2015). The common involvement of health care workers and food handlers who are not specifically trained in food handling, matters pertaining to HACCP, but continue to receive, distribute and serve food in hospitals is a matter of concern in public hospitals.

Private food service, although regarded as the most efficient method of food production, is considered to be the most complicated production process in the hospital environment (Fusi, Guidetti and Azapagic, 2016). With the current political dilemma and democratization of governments and/or states, the use of private food production systems in the public hospital environment could have a negative effect on both the safety and the quality of food, due to the complexity of the supply of normal therapeutic diets and the special diets which are the basic methods of food supply in the hospital environment (Neriz, Núñez, & Ramis, 2014).

2.8. Hospital Food Safety Measures

The provision of safe food is essential in order to protect healthy individuals from consuming food infected by bacteria and parasites. The Food and Drug Administration (FDA) advises, regulates and ensures food safety to alleviate the unwanted and/or improper handling of food which could promote the spread of food borne diseases causing bacteria in the society (WHO, 2015). Foodborne disease outbreaks occur as a result of poor food safety controls during the production chain in food production kitchens. These outbreaks happen due to wrongful processing methods, poor packaging and the inappropriate storage and distribution of the food products to various delivery points (Food Code, 2013).

According to the Centre for Disease Control (CDC), about 76 million cases of food borne illnesses are reported annually in the United States with approximately 5000 deaths. Approximately 500 outbreaks of food-borne diseases are reported annually to the CDC in Atlanta. Food borne illness is also a serious health concern in India (Goel, et al., 2014).

2.9. HACCP Practice in Hospital Food Services

HACCP is a key element of modern food safety management practices. Thus, the design, implementation, control and management of the HACCP system is crucial to the production of safe food products (Trafialek, et al., 2015). An understanding of the factors that contribute to a successful HACCP application is limited and this knowledge is important to the delivery of systems that will control all relevant food safety hazards (Wallace, et al., 2014). Risk Management and risk communication are the two methods mainly used in hospitals to monitor the risks related to food safety and foodborne diseases and other health associated infections in hospitals (Parivash, et al., 2016). The HACCP programme is an example of a risk assessment

technique used to control multiple risk factors. It should be applied consistently to employees' awareness and participation in food preparation and food safety. (Psomas & Kafetzopoulos, 2015).

In a study conducted on 'HACCP and Food Hygiene in Hospitals Knowledge, Attitude, and Practices of Food Service Staff in Calabria in Italy', it was found that out of the 36 hospitals, only 54% of the 27 responding hospitals were using the HACCP system (Angelillo, et al., 2015) and, of those using HACCP, 79% had adopted a food hygiene practice manual; more than one half already had developed written procedures for food storage, personal hygiene, cleaning and disinfection; one half or less performed microbial assessment of foods and surfaces. As a result full implementation of the HACCP system and infection control policies in hospital food services was indeed necessary (Angelillo, et al., 2015). As a matter of principle, HACCP is not, and was never intended to be, a stand-alone food safety programme. Rather HACCP is intended to be part of a larger system of control procedures. For HACCP to function effectively, the procedures should be in place and to understand these controls food handlers need to understand the nature of hazards, as they can be microbiological, chemical and physical (Payne-Palacio, 2014).

2.10. Foodborne Disease Outbreaks in South Africa

Omar (2015) states clearly that food poisoning is a serious health problem, because it can cause severe illness and even death. In South Africa alone, there were reports of outbreaks of foodborne diseases amongst school children in Kwazulu-Natal and Limpopo in 2011 and 2014 respectively, after consuming meals at schools. Again in 2014, the Kwazulu-Natal Department of Education reported that 70 pupils at Esimozomeni Primary School in Richmond,

Pietermaritzburg,, aged between nine and twelve, were affected by an outbreak of suspected food poisoning after they suffered from stomach cramps and vomiting (Niehaus, Apalata, Coovadia, Smith & Moodley, 2011). In South Africa, foodborne disease outbreaks in humans is a rare occurrence (Smith, et al., 2014).

In September 2014, about 238 school pupils in the Sekhukhune area, in Limpopo Province, were examined at two hospitals, Jane Furse Hospital and St Rita's Hospital respectively, for possible food poisoning (Department of Health – Limpopo, 2014). On the 22nd January 2014, 36 health workers attending a workshop at a lodge in Mokopane Town (Waterberg District Municipality, Limpopo, 2014) presented with abdominal cramps, diarrhea and fever. They were hospitalized at Voortrekker Hospital, in Mokopane town (**Limpopo Province Department of Health**, 2014).

2.11. Microbial food safety hazards in hospital

Microbiological food safety is a complex and fundamental issue, which requires proper food receiving, storage, issuing, preparation and service of food to consumers. Therefore, providing safe and nutritious meals to patients in a hospital setting involves a systematic approach to microbiological food safety, as provided by the hazard analysis and critical control points (HACCP) principles (Josic & Giacometti, 2014; Pielaat, et al., 2015). Meals in hospitals are an essential as well as an unavoidable part of patient care, particularly as food supports the intake of drugs. Good food can encourage patients to eat well and at the same time gives them the various nutrients they need in order to recover quickly from surgery and illnesses (Losasso, et al., 2013). Hospitals in general, are regarded as the safest and most hygienic places; however a hospital that is not run well can be a haven for any sort of foodborne disease outbreak and hence can serve as a reservoir of pathogens, especially if care is not taken during the preparation

and serving of food to the consumers (Luangasanatip, et al., 2015). Food products contaminated by pathogenic bacteria are the most common cause of gastroenteritis, and this has been a major public health concern in most communities (Ambrožič, et al., 2016).

Microbiological hazards are a great challenge to food safety due to the potentially harmful microorganisms that have the capability to multiply rapidly from extremely small amounts in food or in the human body after consumption (Tan, et al., 2013). Human hands are the single most important transmitter of disease, as they are in regular contact with the surrounding environment and a variety of pathogens can reach the mucous membranes in the mouth, nose, eyes and genitals of human beings through the hands. Consequently, they contribute to food borne illness outbreaks (Hawker, et al., 2012). A study conducted in Fez Hospital in Morocco on the assessment of the microbiological quality of food and contact surfaces revealed a non-compliance rate of 12% and a great cross contamination between vegetables and raw meat. The study revealed that hospitals did not comply with contact surface regulations for both equipment and kitchen staff's hands (Zbadi, 2014).

The sanitation practices used in the preparation of food and the occurrence of gastrointestinal illnesses affecting people eating in hospitals have raised many concerns worldwide. (Noor, 2016). A study conducted in the hospital kitchen of the National Institute of Urology and Nephrology to determine the microbiological quality of roasted chicken and chicken pan meals indicated the cross contamination of raw chicken, onion, egg and spices, multiplication of the microorganisms during thawing and cutting of chicken, poor hygiene of utensils and equipment, and survival of microorganisms to the cooking process (Yousif, et al., 2013). The cooking and hot-holding of the chicken are the critical control points (CCPs). These results

show the importance of implementing training of food handlers to prevent the occurrences of foodborne diseases (Gaungoo & Jeewon, 2013).

2.12. Food safety training

Food hygiene and safety training ensures that organizations comply with the laws that regulate food safety in food preparation premises. Food hygiene and safety training also minimizes the chances of food contamination or food poisoning, protecting both the public and organizations' reputations (Adesokan, et al., 2015). Training food service staff and food service managers is the first step for best food hygiene practices and an important step to developing a culture of food safety (Nyarugwe, et al., 2016). Failing to continuously train staff in food safety may promote the likelihood of having increased food contamination risks. Increased risk of food contamination will then lead to dissatisfied customers, with potentially huge legal costs and the loss of a good reputation and good market shares (Arendt, Paez, & Strohbehn, 2013).

Food service employees who do not comply with food safety guidelines are mainly those who have not received frequent and adequate training (Fatimah, et al., 2014). Food safety training is related to increased food safety knowledge among food service workers (Kunadu, et al., 2017). However, Hoves, et al. (1996) reported that food service employees do not always practice food safety knowledge as required by food safety regulations Furthermore, conclusions about the effectiveness of food safety training are difficult to make because some studies found that training was successful at improving behaviours (Young, et al., 2015). Several studies have investigated the effects of providing managers with food safety training (McIntyre, et al., 2014). Less research or fewer studies have been conducted relating to the effect of training food handlers (Khalid, 2015). Roberts et al. (2012) evaluated the effectiveness of four – hour ServSafe food safety training by comparing a group of food service employees

who received training with a group who had not. The results have shown that training improved knowledge and overall compliance related to hand washing, use of thermometers, and the correct handling of work surfaces.

The overall microbiological quality of food in catering companies and food service units improves following food safety training, as does the quality of food in the departments with the highest risk for contamination, such as departments involved in food preparation (Viator, et al., 2015). The FDA Food Code provides standards for food safety in food service establishments (Muriana, 2017). It was originally established in 1993 and underwent several revisions, the latest in 1993 (Food and Drug Administration, 2014). More current research is necessary and eminent to evaluate the effectiveness of training food service employees in food safety.

3. CHAPTER 3: RESEARCH METHODOLOGY

3.1. Sampling area

This research project was conducted in the Capricorn District Municipality (CDM). The CDM is located in the centre of the Limpopo Province in South Africa. Limpopo Province is one of the nine provinces in South Africa, situated in the far north of the country and bordering Zimbabwe on the northern side, Mozambique on the eastern side and Botswana on the western side. Limpopo Province is comprised of five other District Municipalities, namely, Bohlabela, Waterberg, Vhembe, Mopani and Sekhukhune as shown in Figure 3.1 below.

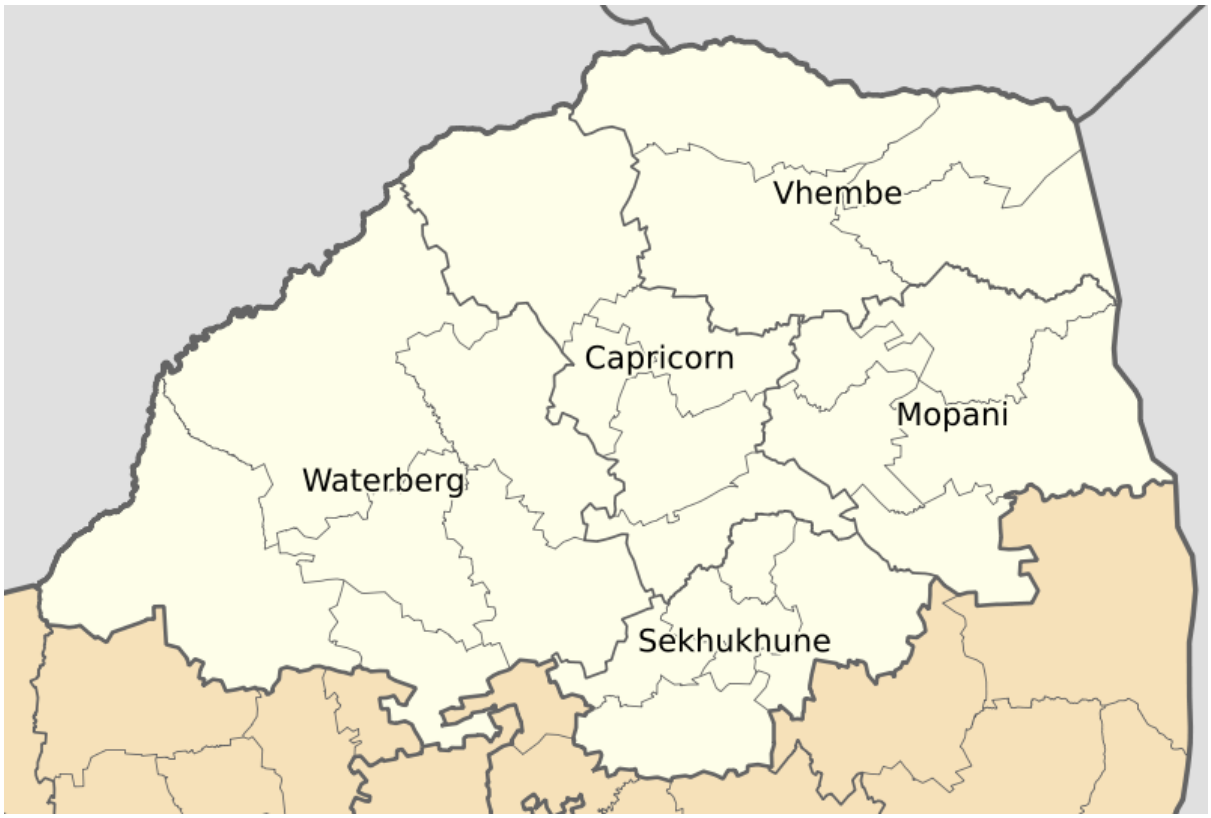

Figure 3.1 Limpopo District Municipalities (Source: Capricorn LED Strategy 2010)

The Capricorn District Municipality has five local municipalities which are Blouberg, Molemole, Lepelle-Nkumbi, Aganang and Polokwane, which is the capital city of Limpopo Province. Polokwane Local Municipality is the largest of the five in terms of gross geographic

product, followed by Lepelle-Nkumbi and Molemole. Blouberg and Aganang have very small economies with the lowest level of income and infrastructure (CDM SoE, 2004).

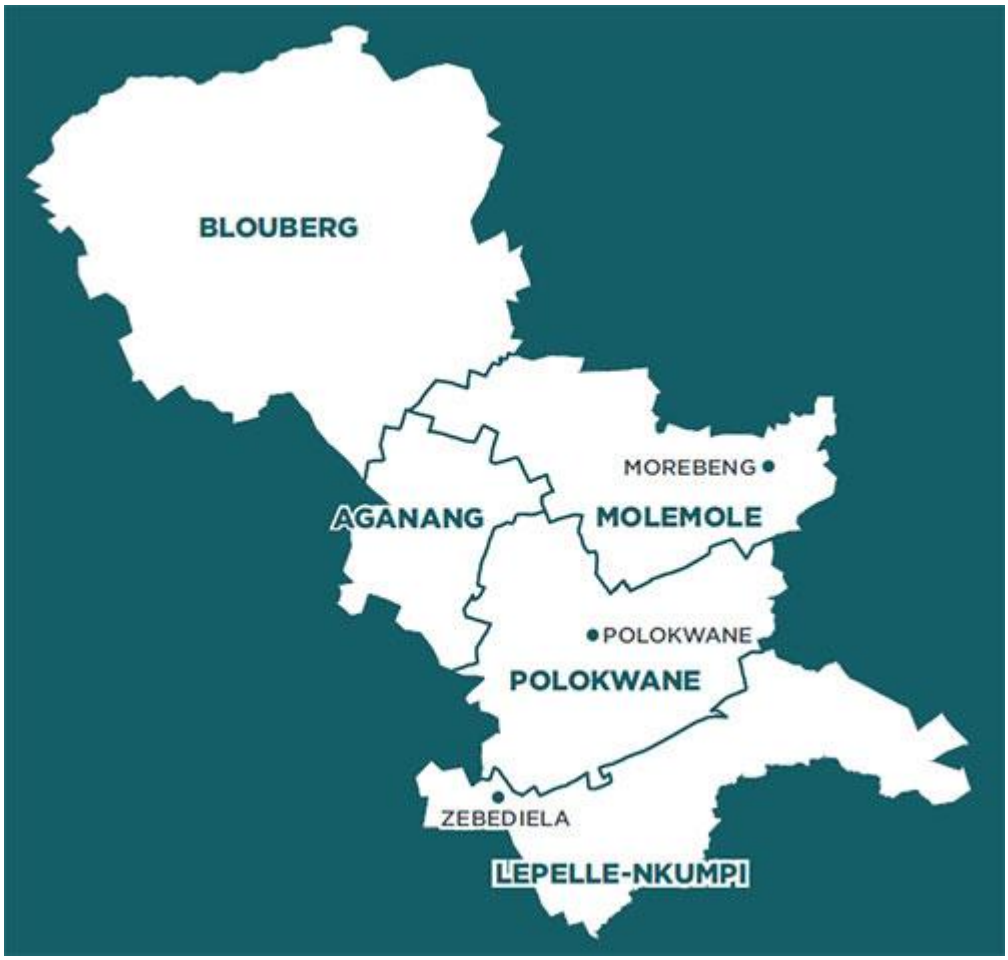

Figure 3.2 Capricorn District Municipalities (*Source: Capricorn LED Strategy 2010)*

Capricorn District Municipality (CDM) which is situated in the centre of the Limpopo Province, shares borders with four other district municipalities, namely: Mopani District Municipality in the east, Sekhukhune District Municipality in the south, Vhembe District Municipality in the north and Waterberg District Municipality in the west. The CDM is situated at the centre or the core of economic development of the Limpopo Province. It is part of the capital of the province, which is the City of Polokwane (formerly known as Pietersburg). It was renamed post 1994, when a historic democracy was proclaimed in South Africa. (Capricorn LED Strategy, 2010).

3.2. Research Design

A cross-sectional descriptive survey research design was used to collect data. A descriptive approach has been followed considering that data was collected without manipulation of any variables or factors.

3.3. Data collection instrument

The data collection instrument was compiled in the form of a questionnaire which also contained an observations checklist. The questionnaire was comprised of four sections: Section 1: Data collection on the socio-biographical data of respondents, including their employment characteristics. Section 2: Data collection to investigate the food safety knowledge, attitudes and foodborne disease awareness of food service employees. Section 3: Data collection to investigate the existence and implementation of an in-house food safety programme (HACCP) and barriers to implementation and Section 4: Data collection to evaluate the adequacy of food service facilities with respect to food safety.

3.4. Sampling and data collection

3.4.1. Sampling of hospitals and respondents

The hospitals, which were included in the study, were selected purposefully due to the small number of hospitals in this region. Nine (09) government hospitals in the Capricorn District Municipality with food service units, which operated in-house catering units, were included in the study. A purposive sampling technique was applied, where all the hospital employees who

were involved in production were included in the study. An estimated total of 480 workers in the food service units were recruited and these included everybody who was involved in the preparation, plating, transporting, serving and distribution of food to the patients and staff.

3.5. Data Collection Techniques

3.5.1. Permission to conduct research

Permission to conduct the study was obtained from the directorate's office of the Limpopo Provincial Department of Health (Appendix 07). A letter explaining the purpose of the study and requesting cooperation was sent to each hospital (Appendix 02). The respondents participating in the study were assured of the confidentiality of the data to be collected. A survey is a very sensitive type of study. As a result, the respondents were given and/or sent invitation letters that explained the procedure and secured their consent to participate in the study; this entailed provision of a written letter and a consent form, which they signed only on participation (Appendices 02 & 03). As a normal practice, it is very important to seek formal consent from the participants as evidence of their consent to participate in the study. The participants were fully informed of the purpose and the intention of the research.

3.5.2. Data collection

Data collection by means of a questionnaire (Appendix 01) was conducted by the main researcher. Each questionnaire took fifteen to twenty minutes to complete.

The questionnaire consisted of a first set of general questions which sought to get the demographic information of the participants (which are variables like age, sex, educational

level, years of experience, current position and the training received). The second set consisted of a number of multiple choice questions which related to food safety and HACCP (i.e. temperature of storing and cooking foods, hand washing, cleaning and disinfectants, spread and multiplication of microorganisms). The last part of the questionnaire was used to determine employee work satisfaction in relation to their duties and their training in food safety.

3.6. Data analysis

The data was analyzed using the statistical package for the social sciences (SPSS version 19) with a Windows application. It is regarded as the most reliable application to analyze simple data. A mixed ANOVA (Analysis of Variance) application was used in the analysis of more complex data because it is considered to be the most suitable method of analyzing complex data and comparing the nature of responses amongst the participants (Norusis 2000).

3.7. Establishment of Validity and Reliability

In order to ensure that the data collection instrument was valid and reliable for this study, a pilot study was conducted. A questionnaire was given to fifteen respondents who were selected randomly from different hospitals in the Capricorn District Municipality. A panel of experts with previous experience in food safety and sanitation was asked to ensure the content validity of the questionnaires by examining the data collection instruments (questionnaires). They used information from previous research publications to ascertain instrument validity for the intended purpose and to ensure that the instrument was appropriate for measuring what it was supposed to measure. In order to ensure reliability and determine the consistency of the questionnaire, the Cronbach's alpha coefficient was used. The 'thumb rule' is this - the higher

the score, the more reliable and consistent is the instrument. Data collected from the pilot study was not used in the final study, as its purpose was to test the suitability of the data collection instrument.

3.8. Ethical Considerations

Permission to conduct the study was obtained from Limpopo Provincial Department of Health (Appendix 07). Ethical clearance was obtained from the Ethics Committee from the College of Agriculture and Environmental Sciences at the University of South Africa (Appendix 06). Respondents were made aware of their right to withdraw from the study and gave their consent by signing the consent form before they could take part in the survey (Appendix 03). The respondents taking part in the study survey were assured of anonymity before they consented to participate and were assured that they would only be identified by job description, age and number of years of formal education. Each participant was informed about the purpose of the survey with the understanding that confidentiality would be assured (Appendix 02).

4. CHAPTER 4: RESULTS

4.1. Socio-demographic characteristics of respondents

Of the 210 respondents who participated in the study, 79%, the majority, were females while 20.5% were males. Regarding racial distribution, the vast majority of the respondents were Africans (99.5%), and the rest were whites (0.5%). No Coloured, no Indian, or Asian / other race groups participated in the study. The majority of respondents were between 18 and 35 years (68.8%) and single (64.8%), and only 31% were married. The rest were divorced, widowed or separated (4.2%). The majority of respondents (63.3%) had obtained qualifications higher than the high school Matric certificate, out of which, 33.3% had obtained a college certificate/diploma, 5.7% a higher certificate/diploma and 24.3% a bachelor's degree (Table 4.1).

Table 4.1: Biographic information of respondents (N=210)

Table 4.1: Biographic information of Hospital employees in CDM (N=210)

Variables		Frequency (%)
1.1 Gender	Female	167(79.5)
	Male	43(20.5)
1.2 Race	African	209(99.5)
	White	1(0.5)
	Indian	0
	Coloured	0
	Asian/others	0
1.3 Age	18- 25 years	73(34.8)
	26-35 years	44(21)
	36-45 years	50(23.8)
	46-55 years	24(11.4)
	56-65	19(9)
1.4 Marital status	Single	136 (64.8)
	Married	65(31)
	Divorced	3(1.4)
	Widowed	4(1.9)
	Separated	2(1)
1.5 Level of education	Below matric certificate	24(11.4)
	Matric certificate	53(25.2)
	Certificate/Diploma	70(33.3)
	Higher certificate/Higher diploma	12(5.7)
	Bachelor’s degree/Postgraduate certificate	51(24.3)

4. 2. Employment and training details of respondents

The majority of the respondents were full-time employees (71%), while the others were either part-time (1.9%) or temporary employees (27.1%). Regarding their current employment position, the majority of the respondents were health care staff (70.5%), followed by chefs (16.2%), food service supervisors (5.7%), food service managers (4.8%) and support staff (2.9%). Most of the respondents (55.5%) had more than 4 years of work experience as a food handler, out of which 20.5% of them had between 5-7 years, while 10% had between 8-10 years and 24.8% had above 10 years. A huge majority of respondents (70%) earned R10000 or lower, out of which 28.1% earned below R5000 and 41.9% between R5001-R10000. Only a minority of respondents (29%) had attended a food safety training course, out of which 12.9% were issued with a training certificate. Similarly, only 27.6% of the respondents had received in-house food hygiene training in their current facilities (Table 4.2).

Table 4.2: Employment and training details of respondents (N=210)

Variables		Frequency (%)
1.6 Type of employment	Full time	149(71)
	Part time	4(1.9)
	Temporal	57(27.1)
1.7 Current employment position	Food Service Manager	10(4.8)
	Food Service Supervisor	12(5.7)
	Chef	34(16.2)
	Health care staff	148(70.5)
	Support staff	6(2.9)
1.8 Experience in food handling practices	Under 2 years	38 (18)
	2-4 years	56(26.7)
	5-7 years	43(20.5)
	8-10 years	21(10)
	Above 10 years	52(24.8)
1.9 Income per month	Below R5000	59(28.1)
	R5001-R10000	88(41.9)
	R10001-R15000	32(15.2)
	R15001-R20000	17(8.1)
	Above R20000	14(6.7)
1.10 Food Safety Training course	Yes: Certificate issued	27(12.9)
	Yes: No Certificate issued	34(16.1)
	No	149(71)
1.11 In-house food hygiene training	Yes	58(27.6)
	No	152(72.4)

4.3. Knowledge on the HACCP plan

Only 49.1% of the respondents correctly indicated hazard analysis as the first step in developing a HACCP plan. A small majority of respondents (55.2%) correctly indicated the checking of the temperature of a roast during cooking entails Monitoring. Only 49.1% of the respondents correctly indicated 'Conduct hazard analysis' as the first step in the HACCP plan. Similarly, only 47.6% of respondents correctly indicated that the discarding of a pot of stew which has not reached the critical temperature limit during cooking, constituted Corrective action. Furthermore, only 17.6% of respondents correctly indicated the monitoring cooling temperature as a critical control point for sandwiches that are served cold in a vending machine. (Table 4.3).

Respondents within the subgroups of level of education, job position and years of experience as food handlers, significantly ($p \leq 0.05$) differ in the manner they responded to two out of four knowledge questions on the HACCP plan. Their attendance at a food safety-training course did not influences how respondents correctly answered the HACCP plan questions regarding the first step in developing a HACCP plan and the correct critical control point for serving cold-stored sandwiches from a vending machine. In terms of differences in responses due to levels of education and years of experience in food handling practices, the partial cross tabulation (PCT) results; PCT1& PCT4, PCT3 & PCT6 respectively, indicated that the knowledge of respondents on these two HACCP plan questions was not influenced by higher education qualifications and greater years of experience as food handlers. Alternatively, PCT 2 & PCT5 indicated that food service managers had the best response to these two HACCP plan questions (Table 4.4).

Table 4.3: Respondents' answers to knowledge questions based on the Hazard Analysis Critical Control Point (HACCP) plan (N=210)

Knowledge questions on the HACCP plan and answer options		Frequency (%)
2.1.1. What is the first step in developing a HACCP plan?	Identifying corrective actions	49(23.3)
	Conduct hazard analysis	**103(49.1)**
	Establish monitoring procedures	28(13.3)
	Determine critical control points	30(14.3)
2.1.2. In the HACCP system, the checking of the temperature of a roast during cooking is referred to as…?	Verification	47(22.4)
	Monitoring	**116(55.2)**
	Record keeping	12(5.7)
	Hazard analysis	35(16.7)
2.1.3. In the HACCP system, the discarding of a pot of stew which has not reach critical temperature limit during cooking is referred to as…??	Monitoring	34(16.2)
	Verification	18(8.6)
	Hazard analysis	58(27.6)
	Corrective action	**100(47.6)**
2.1.4. In the HACCP system, the correct critical control point for preparation of sandwiches that are served cold in a vending machine is referred to as …?	monitoring Storage temperature	105(50.0)
	monitoring Cooling temperature	**37(17.6)**
	monitoring Cooking temperature	11(5.2)
	monitoring Reheating temperature	57(27.1)
NB: Correct answer indicated in bold		

Table 4.4: ANOVA of respondents' answers to knowledge questions based on the HACCP plan (N=440)

	ANOVA between groups (p-value)			
Knowledge questions	**1.4 Level of Education**	**Q1.9 job position/description**	**Q1.8Experience in food handling practices**	**1.10 Food safety training course attendance**
2.1.1. What is the first step in developing a HACCP plan?	**0.000** **¥PCT 1**	**0.009** **¥PCT 2**	**0.014** **¥PCT 3**	0.441
2.1.2. In the HACCP system, the checking of the temperature of a roast during cooking is referred to as…?	0.400	0.255	0.341	0.131
2.1.3. In the HACCP system, the discarding of a pot of stew which has not reach its critical temperature limit during cooking is referred to as…?	0.095	0.216	0.121	0.423
2.1.4. In the HACCP system, the correct critical control point for sandwiches that are served cold in a vending machine is referred to as …?	**0.039** **¥PCT 4**	**0.259** **¥PCT 5**	**0.000** **¥PCT 6**	0.533
¥: Significance at $p \leq 0.05$, **PCT**: Partial Cross Tabulation, **CA** = Correct Answer, **WA**= Wrong Answer				
PCT 1: Below metric (CA=83.3%, WA=16.7%), Matric certificate (CA=32.1%; WA=67.9%), Certificate/Diploma (CA=44.3%, WA=55.7%), Higher Certificate/Diploma (CA=41.7%, WA=58.3%), Bachelor degree and above (CA=58.8%; WA=41.2%).				
PCT 2: Food service manager (CA=80%, WA=20%), Food service supervisor (CA=75%; WA=25%), Chef (CA=61.8%, WA=38.2%), Support staff (CA=66.7%; WA=33.3%), Health care staff (CA=41.2%; WA=58.8%).				
PCT 3: Under 2 years (CA=52.6%, WA=47.4%), 2-4 years (CA=41.1%; WA=58.9%), 5-7 years (CA=44.2%, WA=55.8%), 8-10 years (CA=28.6%, WA=71.4%), Above 10 years (CA=67.3%; WA=32.7%).				
PCT 4: Below metric (CA=79.2%, WA=20.8%), Matric certificate (CA=45.3%, WA=54.7%), Certificate/Diploma (CA=47.1%, WA=52.9%), Higher Certificate/Diploma (CA=58.3%, WA=41.7%), Bachelor degree and above (CA=43.1%; WA=56.9%).				
PCT 5: Food service manager (CA=79.2%, WA=20.8%), Food service supervisor (CA=58.3%; WA=41.7%), Chef (CA=64.7%, WA=35.3%), Support staff (CA=66.7%; WA=33.3%), Health care staff (CA=45.9%; WA=54.1%).				
PCT 6: Under 2 years (CA=44.7%, WA=55.3%), 2-4 years (CA=33.9%; WA=66.1%), 5-7 years (CA=39.5%, WA=60.5%), 8-10 years (CA=66.7%, WA=33.7%), Above 10 years (CA=73.1%; WA=26.9%).				

4.2.3. Knowledge on Receiving and Storage of food

The majority of respondents (59.0) correctly indicated 5˚C or lower as the correct temperature for receiving TCS food. Similarly, only a few respondents (8.1%) correctly indicated 7 days as the correct maximum duration for which prepared ready-to-eat TCS food prepared in-house be stored at 5˚C. The majority of respondents (71.4%) correctly indicated 'In front of food with later use-by dates' as the correct place on a shelf where food with earliest use-by dates can be placed when using the FIFO protocol (Table 4.5).

Respondents within the subgroups under the level of education and experience in food handling significantly ($p \leq 0.05$) differ in the manner they responded to the question on the correct temperature for receiving TCS food. Similarly, Respondents within the subgroups under the level of education and food safety training attendance significantly ($p \leq 0.05$) differ in the manner they responded to the question on the correct temperature for receiving TCS food. PCT1, PCT2, PCT3 and PCT4 showed that respondents with higher levels of education, job position or those who have attended food safety training were not necessarily more knowledgeable in providing the correct responses to knowledge questions (Table 4.6).

Table 4.5: Respondents' answers to knowledge questions based on Receiving and Storage of temperature control for safety foods (TCS) (N=210)

Knowledge questions on receiving and storage of TCS foods and answer options		Frequency (%)
2.1.5. Which of the following is the correct temperature for receiving TCS food?	0˚C or lower	16(7.6)
	5˚C or lower	**124(59.0)**
	7˚C or lower	33(15.7)
	10˚C or lower	36(17.1)
2.1.6. Which of the following is the maximum duration for which prepared ready-to-eat TCS food prepared in-house is stored at 5˚C?	3 days	167(79.5)
	5 days	26(12.4)
	7 days	**17(8.1)**
	9 days	0(0)
2.1.7. The correct place on a shelf where food with earliest use-by dates is placed when using the FIFO protocol?	Below food with later use-by dates	32(15.2)
	Behind food with later use-by dates	23(11.0)
	In front of food with later use-by dates	**150(71.4)**
	Alongside food with later use-by dates	5(2.4)
NB: Correct answer indicated in bold		

Table 4.6: ANOVA of respondents' response to knowledge questions based on receiving and storage of TCS food

	ANOVA between groups (p-value)			
Knowledge questions	**1.4 Level of Education**	**Q1.9 job position/description**	**Q1.8 Experience in food handling practices**	**1.10 Food safety training course attendance**
2.1.5. Which of the following is the correct temperature for receiving TCS food?	**0.039** **¥PCT 1**	0.057	**0.006** **¥PCT 2**	0.403
2.1.6. Which of the following is the maximum duration for which prepared ready-to-eat TCS food prepared in-house is stored at 5˚C?	0.395	0.275	0.347	0.186
2.1.7. The correct place on a shelf where food with earliest use-by dates can be placed when using the FIFO protocol?	**0.005** **¥PCT 3**	0.726	0.117	**0.004** **¥PCT 4**
¥: Significance at $p \leq 0.05$, **PCT**: Partial Cross Tabulation, **CA** = Correct Answer, **WA**= Wrong Answer				
PCT 1: Below metric (CA=83.3%, WA=16.7%), Matric certificate (CA=47.2%, WA=52.8.6%), Certificate/Diploma (CA=57.1%, WA=42.9%), Higher Certificate/Diploma (CA=50%, WA=50%), Bachelor degree and above (CA=64.7%; WA=35.3%).				
PCT 2: Under 2 years (CA=52.6%, WA=47.4%), 2-4 years (CA=41.1%; WA=58.9%), 5-7 years (CA=65.1%, WA=34.9%), 8-10 years (CA=71.4%, WA=28.6%), Above 10 years (CA=73.1%; WA=26.9%).				
PCT 3: Below metric (CA=79.2%, WA=20.8%), Matric certificate (CA=66.6%, WA=33.3%), Certificate/Diploma (CA=60%, WA=40%), Higher Certificate/Diploma (CA=66.7%, WA=33.3%), Bachelor degree and above (CA=90.2%; WA=9.8%).				
PCT 4 Yes: certificate issued (CA=44.4%, WA=55.6%), Yes: no certificate issued (CA=76.5%; WA=23.5%), No (CA=75.2%; WA=24.8%).				

4.2.4. Knowledge on cooking temperature regimes and contamination risks

Most of the respondents did not know the minimum internal cooking temperature for meat, poultry, seafood and eggs. Only 9.05% of respondents correctly indicated 74°C for 15 seconds as the correct minimum internal cooking temperature for meat, poultry, and seafood. Similarly, only 17.6% of respondents correctly indicated 68°C for 15 seconds as the correct minimum internal cooking temperature for eggs that will be hot-held for service. Furthermore, only 24.8% of respondents correctly indicated 68°C for 15 seconds as the correct minimum internal cooking temperature requirement for ground beef. Only 31.9% of respondents correctly indicated 'Thawing in the refrigerator' as the best way to safely thaw frozen meat.

Regarding cross contamination, the vast majority of respondents (72.9%) correctly indicated 'Cross-contamination of food' as a potential consequence of not cleaning and sanitizing a food preparation table after use. (Table 4.7).

Respondents within the subgroups under the level of education, job position and years of experience as food handlers, significantly ($p \leq 0.05$) differ in the manner they responded to two out of four knowledge questions on temperature control. PCT1, PCT2, PCT3, PCT 4, PCT5 & PCT6 indicated that respondents with higher levels of education, years of experience as food handlers and within different job positions were not necessarily more knowledgeable in the provision of correct answers to knowledge questions regarding the correct minimum internal temperature for cooking eggs and the best way to safely thaw ground meat (4.8)

Table 4.7: Respondents' response to knowledge questions based on temperature control and food contact surface contamination risks (N=210)

Knowledge variables on temperatures control food contact surface contamination risks and answer options		**Frequency (%)**
2.1.8. Which of the following is the correct minimum internal cooking temperature requirement for meat, poultry and seafood?	57^{o}C for 15 seconds	95(45.2)
	63^{o}C for 15 seconds	76(36.2)
	68^{o}C for 15 seconds	20(9.5)
	74^{o}C for 15 seconds	**19(9.05)**
2.1.9. Which of the following is the correct minimum internal cooking temperature requirement for eggs that will be hot-held for service?	57^{o}C for 15 seconds	100(47.6)
	63^{o}C for 15 seconds	50(23.8)
	68^{o}C for 15 seconds	**37(17.6)**
	74^{o}C for 15 seconds	23(11.0)
2.1.10. Which of the following is the minimum internal cooking temperature requirement for ground beef?	57^{o}C for 15 seconds	21(10.0)
	63^{o}C for 15 seconds	43(20.5)
	68^{o}C for 15 seconds	**52(24.8)**
	74^{o}C for 15 seconds	94(44.8)
2.1.11. Which of the following is the best way to safely thaw frozen meat?	Thawing at room temperature	71(33.8)
	Thawing in the refrigerator	**67(31.9)**
	Thawing under a bowl of cold water	31(14.8)
	Thawing by heating in the microwave	41(19.5)
Food contact surface contamination risks		**Frequency (%)**
2.1.12. Which of the following is a potential consequence of not cleaning and sanitizing a food preparation table between uses?	Off flavours in food	22(10.5)
	Cross-contamination of food	**153(72.9)**
	Toxic-metal poisoning	30(14.3)
	Time-temperature abuse	5(2.4)
2.1.13. Which section of a serving plate that food handler should avoid touching when serving customers?	The Bottom	29(13.8)
	The edge	48(22.9)
	The top	**133(63.3)**
NB: Correct answer indicated in bold		

Table 4.8: ANOVA of respondents' responses to knowledge questions based on temperatures control and food contact surface contamination risks (N=210)

	ANOVA between groups (p-value)			
Knowledge questions	**1.4 Level of education**	**Q1.9 job position/ description**	**Q1.8 Experience in food handling practices**	**1.10 Food safety training course attendance**
Temperatures control				
2.1.8. Which of the following is the correct minimum internal cooking temperature requirement for meat, poultry, and seafood?	0.464	0.271	0.249	0.379
2.1.9. Which of the following is the correct minimum internal cooking temperature requirement for eggs that will be hot-held for service?	**0.000**¥ PCT 1	**0.000** ¥PCT 2	**0.062** ¥PCT 3	0.524
2.1.10. Which of the following is the minimum internal cooking temperature requirement for ground beef?	0.446	0.547	0.966	0.742
2.1.11. Which of the following is the best way to safely thaw frozen meat?	**0.000** ¥PCT 4	**0.001** ¥PCT 5	**0.000** ¥PCT 6	0.074
Food contact surface contamination risks				
2.1.12. Which of the following is a potential consequence of not cleaning and sanitizing a food preparation table between uses?	0.096	0.537	0.544	0.276
2.1.13. Which section of a serving plate that food handler should avoid touching when serving customers?	0.451	0.966	0.523	0.079
¥: Significance at $p \leq 0.05$, **PCT**: Partial Cross Tabulation, **CA** = Correct Answer, **WA**= Wrong Answer				
PCT 1: Below metric (CA=66.7%, WA=33.3%), Matric certificate (CA=11.3%, WA=88.7%), Certificate/Diploma (CA=8.6%, WA=91.4%), Higher Certificate/Diploma (CA=16.7%, WA=83.3%), Bachelor degree and above (CA=13.7%; WA=86.3%).				
PCT 2 Food service manager (CA=0%, WA=100%), Food service supervisor (CA=33.3%, WA=66.7%), Chef (CA=41.2%, WA=58.8%), Support staff (CA=16.7%, WA=83.3%), Health care staff (CA=12.2%; WA=87.8%).				
PCT 3 Under 2 years (CA=13.2%, WA=86.8%), 2-4 years (CA=16.1%; WA=83.9%), 5-7 years (CA=9.3%, WA=90.7%), 8-10 years (CA=14.3%, WA=85.7%), Above 10 years (CA=30.8%; WA=69.2%).				
PCT 4: Below metric (CA=83.3%, WA=16.7%), Matric certificate (CA=26.4%, WA=73.6%), Certificate/Diploma (CA=21.4%, WA=78.6%), Higher Certificate/Diploma (CA=8.3%, WA=91.7%), Bachelor degree and above (CA=33.3%; WA=66.7%).				
PCT 5: Food service manager (CA=50%, WA=50%), Food service supervisor (CA=41.7%, WA=58.3%), Chef (CA=58.8%, WA=41.2%), Support staff (CA=50%, WA=50%), Health care staff (CA=23%; WA=77%).				
PCT 6 Under 2 years (CA=39.5%, WA=60.5%), 2-4 years (CA=17.9%; WA=82.1%), 5-7 years (CA=20.9%, WA=79.1%), 8-10 years (CA=23.8%, WA=76.2%), Above 10 years (CA=53.8%; WA=46.2%).				

4.3. Safe food handling attitudes

After analyzing the variables involved, the majority of respondents had the correct attitude to safe food handling. With regards to the receiving and storage of food, up to 70.5% agreed that food stored at an incorrect temperature should always be discarded. 70.0% indicated that they checked the temperature of refrigerators at least once per day while 87.6% indicated that they always separate raw and cooked food during storage. Regarding the respondents' attitude towards food handling and contamination risks, up to 82.4% of respondents indicated they would not go to work and partake in food preparation when they had diarrhoea. Similarly 89.5% of respondents indicated that they continued to wash their hands during food preparation, even if others did not wash theirs. Up to 77.6% believed that their individual food handling practices could impact the food safety standards in their food preparation facilities. The vast majority, namely 94.8%, agreed that it is important to improve food handling practices to reduce the risk of foodborne illnesses. (Table 4.9)

Table 4.9: Safe food handling attitudes of respondents

Attitude questions on Safe food handling and answer options		**Frequency (%)**
Receiving and Storage		
2.2.1. Do you believe that food stored at an incorrect temperature must always be discarded?	**Yes**	**148(70.5)**
	No	43(20.5)
	No idea	19(9.0)
2.2.2. Do you always check the temperature of refrigerators at least once per day?	**Yes**	**147(70.0)**
	No	53(25.2)
	No idea	10(4.8)
2.2.3. Do you always separate raw and cooked food during storage?	**Yes**	**184(87.6)**
	No	20(9.5)
	No idea	6(2.9)
Food handling and contamination risks		
2.2.4. Do you always avoid partaking in food preparation when you have diarrhoea?	**Yes**	**173(82.4)**
	No	33(15.7)
	No idea	4(1.9)
2.2.5. Do you always wash your hands during food preparation, even if others do not wash theirs?	**Yes**	**188(89.5)**
	No	19(9.0)
	No idea	3(1.4)
2.2.6. Do you think it is important to improve hygiene practices to reduce the risk of foodborne illnesses.	**Yes**	**199(94.8)**
	No	5(2.4)
	No idea	6(2.9)
NB: Correct attitude indicated in bold		

4.4. Knowledge of foodborne bacteria and diseases

The minority of respondents gave correct answers to the knowledge questions concerning foodborne bacteria and diseases. 47.1% correctly indicated *Salmonella* sp as the main foodborne bacterial pathogen mostly associated with poultry products while 38.1% correctly indicated that foodborne bacteria will grow quickly in food that reaches a temperature of 37 ˚C. The vast majority of respondents (91.9%) correctly indicated diarrhoea as the most common symptom for food poisoning. Similarly, the majority of respondents (66.7%) correctly indicated that preschool-age children are at a greater risk of contracting foodborne illnesses because they have not built up strong immune systems. The majority of respondents (71.4%) correctly indicated that children, older people and pregnant women are also more vulnerable to foodborne diseases (Table 4.10).

Respondents' replies to questions relating to the level of education, job position and Food safety training course attendance, significantly ($p \leq 0.05$) differed in the manner they responded to the two Knowledge questions on food-borne pathogens. PCT 1, PCT2, PCT3, PCT 4, PCT5 & PCT6 indicated that respondents with higher levels of education, job position and who had attended a food safety training course did not differ in their response to knowledge questions on the main foodborne bacteria associated with poultry and regarding what would happen to foodborne bacteria in food when the temperature of food reached 37 ˚C (Table 4.10). Respondents within the subgroups under the level of education, and food safety training course attendance, significantly ($p \leq 0.05$) differed in the manner they responded to the two Knowledge questions concerning the group of people that are more vulnerable to food borne diseases. PCT7 & PCT8 indicated that respondents with higher levels of education and those that had attended food safety training course were not necessarily more knowledgeable (Table 4.11).

Table 4.10: Respondents' response to knowledge questions based on food-borne pathogens and diseases (N=210)

Knowledge questions on food-borne pathogens and answer options		**Frequency (%)**
2.3.1. Which of the following is the main foodborne bacteria pathogens, mostly associated with poultry products?	**Salmonella**	**99(47.1)**
	Staphylococcus	39(18.6)
	E. Coli	20(9.5)
	Botulinum	8(3.8)
	Do not know	44(21.0)
2.3.2. Which of the following best explains what will happen to food borne bacteria in food at a temperature of 37 ˚C?	Die	29(13.8)
	Do not grow	41(19.5)
	Grow quickly	**80(38.1)**
	Grow slowly	28(13.3)
	Do not know	32(15.2)
Knowledge questions on food-borne diseases and answer options		**Frequency (%)**
2.3.3. Which of the following is the most common symptom for food poisoning?	Headache	6(2.9)
	Diarrhoea	**193(91.9)**
	Rash	3(1.4)
	Constipation	4(1.9)
	Do not know	4(1.9)
2.3.4. Which of the following best explains why are preschool-age children at a higher risk for foodborne illnesses?	**They have not built up strong immune systems**	**140(66.7)**
	They are more likely to spend time in a hospital	8(3.8)
	They are more likely to suffer allergic reactions	32(15.2)
	Their appetites have increased since birth	4(1.9)
	All of the above	26(12.4)
2.3.5. Which of the following groups of people are more vulnerable to foodborne diseases?	Children	31(14.8)
	Older people	5(2.4)
	Pregnant women	16(7.6)
	All of the above	**150(71.4)**
	I do not know	8(3.8)
NB: Correct answer indicated in bold		

Table 4.11: ANOVA of respondents answers to knowledge questions on food-borne pathogens and diseases (N=210)

	ANOVA between groups (p-value)			
Knowledge questions	**1.4 Level of Education**	**Q1.5 employment position**	**Q1.8Experience in food handling practices**	**Food safety training course attendance**
Food-borne pathogens				
2.3.1. Which of the following is the main foodborne bacteria pathogens mostly associated with poultry products?	**0.000¥[PCT 1]**	**0.002¥[PCT 2]**	0.097	**0.006¥[PCT 3]**
2.3.2. Which of the following best explains what will happen to food borne bacteria in food at a temperature of 37 ˚C?	**0.000¥[PCT 4]**	**0.010¥[PCT 5]**	0.257	**0.022¥[PCT 6]**
Food-borne diseases				
2.3.3. Which of the following is the most common symptom for food poisoning?	0.077	0.127	0.160	0.073
2.3.4. Which of the following best explains why are preschool-age children at a higher risk for foodborne illnesses?	**0.030¥[PCT 7]**	0.317	0.220	**0.043¥[PCT 8]**
2.3.5. Which of the following groups of people are more vulnerable to foodborne diseases?	0.113	0.769	0.320	0.104

¥: Significance at $p \leq 0.05$, **PCT**: Partial Cross Tabulation, **CA** = Correct Answer, **WA**= Wrong Answer

PCT 1 Below metric (CA=75%, WA=25%), Matric certificate (CA=34%, WA=66%), Certificate/Diploma (CA=32.9%, WA=67.1%), Higher Certificate/Diploma (CA=58.3%, WA=41.7%), Bachelor degree and above (CA=64.7%; WA=35.3%).

PCT 2: Food service manager (CA=70%, WA=30%), Food service supervisor (CA=33.3%; WA=66.7%), Chef (CA=85.3%, WA=14.7%), Support staff (CA=33.3%, WA=66.7%), Health care staff (CA=41.7%; WA=58.3%).

PCT 3: Yes: certificate issued (CA=59.3%, WA=40.7%), Yes: no certificate issued (CA=67.6%; WA=32.4%), No (CA=40.3%; WA=59.7%).

PCT 4: Below metric (CA=4.2%, WA=95.8%), Matric certificate (CA=32.1%, WA=67.9%), Certificate/Diploma (CA=40%, WA=60%), Higher Certificate/Diploma (CA=33.3%, WA=66.7%), Bachelor degree and above (CA=58.8%; WA=41.2%).

PCT 5: Food service manager (CA=90%, WA=10%), Food service supervisor (CA=50%, WA=50%), Chef (CA=67.6%, WA=32.4%), Support staff (CA=33.3%, WA=66.7%), Health care staff (CA=39.9%; WA=60.1%).

PCT 6: Yes: certificate issued (CA=29.6%, WA=70.4%), Yes: no certificate issued (CA=58.8%; WA=41.2%), No (CA=34.9%; WA=65.1%).

PCT 7: Below metric (CA=91.7%, WA=8.3%), Matric certificate (CA=56.6%, WA=43.4%), Certificate/Diploma (CA=61.4%, WA=38.6%), Higher Certificate/Diploma (CA=75%, WA=25%), Bachelor degree and above (CA=70.6%; WA=29.4%).

PCT 8: Yes: certificate issued (CA=55.6%, WA=44.4%), Yes: no certificate issued (CA=88.2%; WA=8.8%), No (CA=63.1%; WA=36.9%).

5. CHAPTER 5: DISCUSSION

5.1. Demographics and Employment Characteristics

The reason why the majority of respondents were females can be attributed to the fact that, In South Africa, women have a disproportionate share of all nursing occupations compared to men (South African Census Bureau, 2010). Furthermore, there are generally more females than males in the Limpopo province with a ratio of 0.88:1 respectively (Statistics South Africa, 2011). Furthermore, female food handlers have been found to dominate their male counterparts in many food service establishments (Martins, Hogg & Otero, 2012; Green, et al., 2005). A huge majority of the respondents was found to be Blacks and this is a reflection of the demographics of South Africa in which Blacks constitute up to 79.2% of the total South African population and up to 96.7% of the Limpopo province population (Statistics South Africa, 2011). Furthermore, the Limpopo province is predominantly rural, hence very few people from other racial groups (Whites, Indians and Asians) in South Africa often prefer to live and work in rural areas (Aliber, Baiphethi & Jacobs, 2009; Hall, et al., 2013). The majority of respondents was found to be between 18 and 35 years old, single and were in their early years in their careers, getting involved with food handling in the hospitals (Abdelhafez, 2013; Angelillo, et al., 2000; Tokuc, et al., 2009). The reason why the majority of respondents had obtained a qualification higher than a high school qualification (Matric) can be attributed to the fact that many young black South Africans, post 1994, have had increasingly more access to higher education than they did during the apartheid era (Council of Higher Education, 2015; Shay, 2015). The higher the level of education of food handlers, the easier it becomes for them to acquire food safety knowledge and skill through training (Gaungoo & Jeewon, 2013). The fact that the majority of the respondents were full-time permanent employees is beneficial for the hospitals considering that it ensures continuous improvement in food safety knowledge,

attitudes and the skills of employees through continuous training and skills development without interruptions (Farahat, Ei-Shafie and Waly, 2015). Regarding current employment positions, the majority of the respondents were health care staff and most probably nurses. To a large extent, these workers are the ones who determine the efficiency and effectiveness of hospital operations and constitute the majority of health care practitioners in most hospitals (Everhart, et al., 2015). The reason why most of the respondents have been involved in food handling in their respective hospitals for four (4) years or more, is because most of the food handlers in hospitals are permanently employed on a full time basis and permanent staff do not usually change jobs easily (Dubois, Nolte and McKee, 2006; Jelfs, Knapp, Giepmans & Wijga, 2014; Buchan, et al., 2015). A huge majority of respondents earned below R10000 because many of the food handlers in hospitals are probably lower grade health care professionals and food service employees whose salaries often only increase over time through further training and the acquisition of professional experience (Sharif, Obaidat, and Al-Dalalah, 2013).

The reason why only a minority of respondents have attended a food safety training course can be attributed to the fact that the hospitals did not have a HACCP system in place, therefore resulted in non-implementation and non-existence of food safety policies in hospitals (Dudeja, et al., 2017; Gillespie, Little, and Mitchell, 2000). The lack of food safety policies and food hygiene training programmes could lead to inadequate food safety knowledge, which, in turn, could result in unsafe food handling practices. The probable outcome of this could mean the cross-contamination of food and possibly foodborne disease outbreaks in the food service facilities of hospitals (Choi, et al., 2017; Buccheri, et al., 2010; Rahman, Arif, Bakar, and Tambi, 2012).

5.2. Knowledge on HACCP plan

The majority of respondents could not identify hazard analysis as the first step in a HACCP plan nor could they identify the checking of temperature as a monitoring step during the preparation of roast. Similarly, they could not describe the corrective action required during the storage of a pot of stew or the critical control points for preparation of sandwiches that are served cold. This could be due to a lack of training and failure to implement the HACCP system in the food service facilities of hospitals (Wallace, et al., 2014). Furthermore, the attainment of higher levels of education, better job positions or many years of experience as food handlers did not influences how respondents correctly identified the first step in a HACCP plan and the critical control points for sandwiches that are served cold. This was so, despite the significant differences in their responses to the two knowledge questions. Again this can be due to whether the hospitals were HACCP accredited or not, or due to the lack of HACCP training, if trained, when last were they trained, or due to the food safety culture in hospitals. The provision of food safety training and the implementation of an HACCP system in any food service establishment enables proper identification, analysis and control of food safety hazards. It also improves food safety handling practices and the attitudes of food handlers (Doménech, et al., 2011 and McIntyre, et al., 2013). The production of safe food in hospitals can be more effective if food handlers are well trained (Adebukola, Opeyemi and Aydeji, 2015).

5.3. Knowledge on Receiving and Storage of food

The majority of respondents correctly indicated 5˚C or lower as the right temperature for receiving TCS (temperature controlled for safety) food. This is extremely important, considering that temperature abuse can occur along the food chain if food handlers do not know

the correct receiving temperatures of TCS foods (Derens-Bertheau, et al., 2015). Cooler temperatures can substantially reduce the rate at which food will deteriorate, because low temperatures slow down the growth of microorganisms in food thereby preventing food spoilage in hospitals (Jedermann, Nicomento and Lang, 2014). If food handlers lack the knowledge to apply measures that would ensure the safety of foods served to their customers, this could result in a major food borne outbreak, causing health problems and economic losses. Much of these losses represent lost markets, loss of consumer demand, litigation and food service or catering company closures (Hussain & Dawson, 2013; Scharff, 2012). Similarly, only a few respondents (8.1%) correctly indicated 7 days as the correct maximum duration for which prepared ready-to-eat TCS food prepared in-house could be stored at 5˚C. This can be attributed to the fact that most of the respondents have not received training on storage temperature condition and the use-by-date of TCS food stored at refrigerator temperatures (Roccato, et al., 2017). If TCS food are not stored at the correct temperature and duration, bacteria can grow in these TCS food such as meat, poultry, eggs, fish, shellfish, dairy products, cooked vegetables, cooked rice, cooked cereals, cooked pasta, cooked beans, peas and lentils and render them unsafe for human consumption (Dolan, Matulka, Burdock, 2010). The growth of pathogens such as *Listeria monocytogenes*, *Salmonella* and certain strains of *Bacillus cereus* can lead to food borne infection upon consumption while bacteria such as E.coli 015:H7 and Clostridium botulinum can actually grow and produce heat stable toxins in food (Hansen & Gee, 2014). The majority of respondents also answered correctly by indicating that food with earlier use-by dates should be placed in front of food with later use-by dates when implementing FIFO protocol. FIFO ensures that food stuffs do not remain in storage beyond their shelf life as this can lead to microbial growth and deterioration (Koutsoumanis, et al., 2005).

ANOVA of the response to Knowledge questions on receiving and storage of TCS food

The ANOVA analysis showed that Respondents with higher educational levels were not necessarily more knowledgeable in identifying the correct temperature for receiving TCS foods and correct FIFO procedures. Similarly, those with greater years of experience and those who had attended food safety training were not necessarily more knowledgeable in identifying the correct temperature for receiving TCS foods and the correct FIFO procedure even though food handlers differed significantly in their response to the knowledge questions. Higher levels of education and experience in food handling do not necessarily translate to higher level of food safety knowledge for all food handlers (Brown, Wong, Reimann, Nicholas, Faw, Davis, and Selman, 2014). All food handlers in hospitals must be provided with food safety training. This will not only improve their food safety knowledge but also increase their self-efficacy in safe food handling practices and reduce their anxiety and stress levels (da Cunha, et al., 2015; Hertzman, et al. 2011).

5.5. Knowledge on cooking temperatures and contamination risk

The vast majority of respondents did not know the minimum internal cooking temperature for meat, poultry, seafood, ground beef and eggs as well as the best way to safely thaw frozen meat. This can be attributed to the fact that the sample group was not only made up of people that were involved in the cooking of food, but also those who were not involved in the cooking process but only the distribution part. This constitutes microbial risks because poorly cooked meat and poultry food products can harbor thermophilic Campylobacter species (Stella, et al., 2017), spore forming pathogens such as *Clostridium difficile* (Rodriguez, et al., 2016) as well as non-spore producing pathogens (Schlisselberg, et al., 2013). Foodborne pathogens can grow rapidly at all temperatures but mostly in undercooked foods and this can cause food borne diseases to consumers (Osaili, et al., 2013).

Inadequate thawing of meals can result in the growth of bacteria during food preparation. Thawing potentially hazardous frozen food (PHF), may pose a food safety risk if the temperature of the food is between 5°C and 60°C during thawing, allowing food poisoning bacteria to grow. The food safety risk is much greater for frozen ready-to-eat PHFs than for frozen raw PHFs that will be cooked or otherwise processed to make them safe before eating (FDA, 2013).

The fact that the vast majority of respondents correctly indicated the possibility of cross-contamination of food if the food preparation table was not cleaned and sanitized in between uses means they are be likely to implement this on food preparation surfaces such as cutting boards, table tops and other utensils (Soares, et al., 2012). Most of the food handlers were health care professionals, hence they are likely to be knowledgeable on the prevention of microbial cross-contamination (Sharif, et al., 2013; McLaren, Moyo, and Jeffrey, 2015).

ANOVA of respondents scores to Knowledge questions on cooking temperatures regimens and contamination risk

Even though respondents within the subgroups which identified their level of education, job position and years of experience as food handlers significantly ($p \leq 0.05$) differed in their response to knowledge questions on the minimum internal cooking temperature for eggs and the best way to thaw frozen meat, food handlers with higher levels of education, many more years of experience as food handlers and a particular type of job position were not necessarily more knowledgeable (Osaili, et al., 2013). Knowledge of minimum internal cooking temperatures of food and the thawing procedure for frozen mean can only be achieved through specific education and training on the handling of TCS foods (Osaili, et al., 2017). Training regarding food safety temperature regimes should include knowing the recommended thawing, cooking, holding, and storage temperatures of various TCS foods (Kunadu, et al., 2017). Continuous food safety education and training through refresher courses is required to reassess,

update, maintain and increase the food safety knowledge, attitude and skills of food handlers (Shinbaum, et al., 2016).

5.6. Safe food handling attitudes

Respondents possessed a positive attitude towards the discarding of food stored at incorrect temperatures and the checking of refrigerator temperatures at least once a day. These positive attitudes ensure that foods that have been subjected to temperature abuse and which may contain high microbial loads are not processed for consumption in hospitals (Roccato, et al., 2017). It is important to check the temperature of refrigerators at least once a day considering that time-temperature abuses are the underlying cause of most foodborne disease outbreaks in food service establishments (Younus, Fotedar, and Prangnell, 2015; Roccato, Uyttendaele and Membre, 2017). Similarly, food handlers were found to possess the correct attitude to always separating raw and cooked food stuffs during storage. This practice ensures the prevention of cross contamination between food (Carrasco, Morales-Rueda, and García-Gimeno, 2012)

Most of the respondents also understood they should not go to work if suffering from diarrhea and the importance of always washing their hands during food preparation. Their attitude towards seeking to improve on food handling practices was good. These positive personal hygiene attitudes contribute to the prevention of food borne pathogens being transmitted from the food handler to food (Mitchell, Fraser and Bearon, 2007; Monney, Martinson, Asampana, and Albert, 2014). However, the possession of positive food safety attitudes by food handlers has not always been found to translate into safe food handling practices (Bucheri, et al., 2010)

5.7. Knowledge on food – borne bacteria and food borne diseases

The reason why only the minority of respondents (47,1%) correctly indicated *Salmonella* sp as the main foodborne bacterial pathogen associated with poultry products may be attributed to the lack of microbial hazards knowledge by food handlers, which may be caused by lack of food safety education and training on microbial hazards in foods (Machado & Cutter, 2017). The fact that only a minority of respondents knew that pathogens in food will grow rapidly when food is subjected to temperatures of 37˚C is a concern regarding the correct handling of TCS food in hospitals and the prevention of microbial growth (Akabanda, et al., 2017; Smigic, et al., 2016). The possession of inadequate knowledge of microbial hazards and critical temperature ranges by food handlers has been reported in many studies (Osaili, et al. 2017; Sibanyoni, et al., 2017). This is further supported by the fact that food handlers within different subgroups under the level of education, job position and food safety training course attendance, significantly ($p \leq 0.05$) differed on how they correctly indicated the main foodborne bacteria associated with poultry although they correctly stated that pathogens in food will multiply if the temperature of the food reaches 37˚C. However, higher levels of education, job position and food safety training courses did not enable the food handlers to answer these knowledge questions better than those who did not. The vast majority of respondents correctly indicated diarrhoea as the most common symptom for food poisoning. The vast majority of food handlers who participated in this study were health care professionals with more than 48 months of experience. This could be why the vast majority of food handlers in hospitals were knowledgeable on community health knowledge based questions (Osaili, et al., 2017). This can also explains why food handlers within the subgroups pertaining to levels of education, job position and food safety training course attendance, significantly ($p \leq 0.05$) differed on how they correctly identified the group of people that are more vulnerable to food borne diseases. Higher levels of education, job position and their attendance at food safety training courses did not enable the food handlers to answer these questions more accurately.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

Many food handlers are not knowledgeable about HACCP and the correct temperature and duration for receiving and storing TCS foods respectively. A vast majority of food handlers are not knowledgeable about the minimum internal cooking temperature for poultry, seafood, eggs and the best way of thawing frozen meat. Majority of food handlers do not know that Salmonella is the main foodborne bacteria pathogens mostly associated with poultry products and that foodborne bacteria will grow quickly in food at a temperature of 37 ˚C. The majority of food handlers possess adequate food safety knowledge regarding the safe food handling practices and the prevention of contamination. ANOVA and PCT analyses indicate that respondents with higher academic qualification do not possess more food safety knowledge than those with lower academic qualification. Food handlers who are health care staff have less food safety knowledge when compared to food service managers, food service supervisors and Chefs.

6.2. Recommendations

In order to prevent unintentional food contamination due to lack of adequate food safety knowledge, it is recommended that food handlers should be subjected to food safety educational/training programmes, both before commencing work and on an on-going basis during employment in order to make sure that food handling and food safety practices are constantly adhered to.

It is also recommended that all the line managers should undergo the basic HACCP training, after which they should impart knowledge of the training to their subordinates, in order to implement sound food safety management systems.

It is further recommended that, with the increased level of advanced technology in the food service industry, it is quite clear that temperature controlled for safety foods (TCS), are widely used in large food production. Therefore, it is imperative that food service employees are trained in the area of receiving, storing, and preserving the quality of TCS foods.

A hospital area is a very sensitive environment in terms of food safety. Therefore, it is of importance to make sure that food handlers are taught about various foodborne pathogens and the correct temperatures for holding hot foods, storing cold foods and cooked foods in order to avoid the growth of foodborne pathogens in food.

Lastly, it is recommended that all food handlers, irrespective of their level of education and/or occupation (positions they occupy in their respective area of work), should be subjected to refresher courses or training in food safety, because research results show that respondents with higher academic qualification do not possess more food safety knowledge than those with lower academic qualifications

Food handlers who are health care staff have less food safety knowledge when compared to food service managers, food service supervisors and Chefs.

6.3. Limitations of the study

The study sample was limited to the Capricorn District Municipality, and the results of this study should not be generalized. In addition, this research study was based on self-reported food safety knowledge and attitudes; thus the results from the present study should not be

generalized to all food handlers in other municipal districts in the province. Nonetheless, the present results can provide more important information for promoting food safety training and other interventions for food handlers in hospitals. Further surveys using more comprehensive assessment tools and more representative samples are needed.

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APPENDICES

Appendix 1: Questionnaires

SECTION 1: DEMOGRAPHICS AND EMPLOYMENT CHARACTERISTICS

Please choose 1 answer for each question

1.1. What is your gender?

1	Male
2	Female

1.2. Race

African	Coloured	Indian	White	others
1	2	3	4	5

1.3 What is your age?

18- 25 years	26-35 years	36-45 years	46-55 years	56-65 years	66-75 years
1	2	3	4	5	6

1.4 What is your marital status?

Single	Married	Divorced	Widowed	Separated	Never married
1	2	3	4	5	6

1.5. Which of the following best describes your highest education level?

Less than matric	Matric certificate	Certificates or diploma	Higher diploma	University degree
1	2	3	4	5

1.6. Your current employment status in this establishment_____

employed full-time	employed part-time	Voluntary worker
1	2	3

1.7. Which of the following corresponds with your current employment position in this institution?

Food service Manager	Food service supervisor	Cooks/Chef	Support staff	Health care
1	2	3	4	5

1.8. Years of work experience in a food service facility

Under 2 years	2-4 years	5-7 years	8-10 years	> 10 years
1	2	3	4	5

1.9. Your current income per month in this employment_____

Under R5000	R5001-R10000	R10001-R15000	R15001-R20000	Above R20000
1	2	3	4	5

1.10. Have you completed any food safety training course/program?

YES: A certificate was issued	Yes: No certificate was issued	No training course attended
1	2	3

1.11. Have you attended any in house food hygiene training?

YES	NO
1	2

SECTION 2: THE FOOD SAFETY KNOWLEDGE, ATTITUDES AND FOOD BORNE DISEASE AWARENESS OF FOOD SERVICE EMPLOYEES

SUB-SECTION 2.1: Food Safety Knowledge

Knowledge on Policies, Training and Food Safety Programs

2.1.1. What is the first step in developing a HACCP plan?

1	Identifying corrective actions
2	**Conduct hazard analysis**
3	Establish monitoring procedures
4	Determine critical control points

2.1.2. In the HACCP system, the checking of the temperature of a roast during cooking is referred to as…?

1	Verification
2	**Monitoring**
3	Record-keeping
4	Hazard analysis

2.1.3. In the HACCP system, the discarding of a pot of stew which has not reach critical temperature limit during cooking is referred to as…?

1	Monitoring
2	Verification
3	**Hazard analysis**
4	Corrective action

2.1.4. In the HACCP system, the correct critical control point for sandwiches that are served cold in a vending machine is referred to as …?

1	**Storage**
2	Cooling
3	Cooking
4	Reheating

Knowledge on Receiving and Storage

2.1.5. Which of the following is the correct temperature for receiving TCS food?

1	0˚C or lower
2	**5˚C or lower**
3	7˚C or lower
4	10˚C or lower

2.1.6. Which of the following is the maximum duration for which prepared ready-to-eat TCS food prepared in-house be stored at 5˚C?

1	3 days
2	5 days
3	**7 days**
4	9 days

2.1.7. The correct place on a shelf where food with earliest use-by dates is placed when using the FIFO protocol?

1	Below food with later use-by dates
2	Behind food with later use-by dates
3	**In front of food with later use-by dates**
4	Alongside food with later use-by dates

Knowledge on Food Preparation and Cooking

2.1.8. Which of the following is the correct minimum internal cooking temperature requirement for meat, poultry, and seafood?

1	57C
2	63C
3	68C
4	**74C**

2.1.9. Which of the following is the correct minimum internal cooking temperature requirement for eggs that will be hot-held for service?

1	57C for 15 seconds
2	63C for 15 seconds
3	**68C for 15 seconds**
4	74 C for 15 seconds

2.1.10. Which of the following is the minimum internal cooking temperature requirement for ground beef?

1	57C for 15 seconds
2	63C for 15 seconds
3	**68C for 15 seconds**
4	74C for 15 seconds

Knowledge on Food Handling and Cross-contamination

2.1.11. Which of the following is the best way to safely thaw frozen meat?

1	At room temperature
2	**In the refrigerator**
3	Under cold water
4	Using the microwave oven

2.1.12. Which of the following is a potential consequence of not cleaning and sanitizing a food preparation table between uses?

1	Off flavours in food
2	**Cross-contamination**
3	Toxic-metal poisoning
4	Time-temperature abuse

2.1.13. Which section of a serving plate that food handler should avoid touching when serving customers?

1	Bottom
2	Edge
3	Side
4	**Top**

SUB-SECTION 2.2: Food Safety Attitudes

2.2.1. Do you believe that food stored at incorrect temperature must always be discarded?	1: YES	2: NO	3: No Idea
2.2.2. Do you check the temperature of refrigerators at least once per day?	1: YES	2: NO	3: No Idea
2.2.3. Will you always separate raw and cooked during storage?	1: YES	2: NO	3: No Idea
Handling / Cross contamination Prevention			
2.2.4. Will you still go to work when you have diarrhoea?	1: YES	2: NO	3: No idea
2.2.5. Will you continue to wash your hands during food preparation, even if others do not wash theirs?	1: YES	2: NO	3: No idea
2.2.6. It is important to improve food handling practices to reduce the risk of foodborne illnesses.	1: YES	2: NO	3: No idea

SUB-SECTION 2.3: Food Borne Disease Awareness

2.3.1. Which of the following is the main cause of foodborne disease in poultry products?

1	**Salmonella**
2	Staphylococcus
3	E. Coli
4	Botullinum
5	Do not know

2.3.2. At body temperature (37 ˚C) what will food poisoning bacteria do?

1	Die
2	Do not grow
3	**Grow quickly**
4	Grow slowly
5	Do not know

2.3.3. Which is a common symptom of food poisoning?

1	Headache
2	**Diarrhoea**
3	Rash
4	Constipation
5	Do not know

2.3.4. Why are preschool-age children at a higher risk for foodborne illnesses?

1	**They have not built up strong immune systems**
2	They are more likely to spend time in a hospital
3	They are more likely to suffer allergic reactions
4	Their appetites have increased since birth
5	All of the above

2.3.5. Foodborne disease is more dangerous for vulnerable groups, for example (i.e. children, older people and pregnant women).

1	Children
2	Older people
3	Pregnant women
4	**All of the above**
5	I do not know

SECTION 3: Existence of an in-house food safety program (HACCP), implementation and barriers

Interview questionnaire with Food Service Supervisors and Food Service Managers

The respondent is only required to answer YES, NO or No Idea (If there is no clue of the answer).

Food Handler Questions			
3.1.1. Are you aware of the pre-requisites programs for implementation of HACCP program?	1: YES	2: NO	3: No idea
3.1.2. Do you use the HACCP program in your establishment? **If you answered 'YES' to question 3.1.1 & 3.1.2 continue with the rest of the questionnaire.**	1:YES	2: NO	3: No idea
3.1.3. Do you think that HACCP program is important for food safety?	1: YES	2: NO	3: No idea
3.1.4. Do you record daily food safety measures in your food service operations?	1: YES	2: NO	3: No idea
3.1.5. Do you think that the prerequisites programs are relevant for HACCP?	1: YES	2: NO	3: No idea

Mention any three (3) challenges which make it difficult to implement the HACCP program in your establishment. Start with the most important ones.

1)_____

__

2)_____

—

3)_____

—

Appendix 2: Covering letter for the questionnaire

QUESTIONNAIRE COVERING LETTER

Dear Respondent

I, Lesiba Augustine Teffo, have registered with the University of South Africa for the Master of Consumer Science Degree. I am conducting a research study on food safety knowledge and food handlers' practices in hospitals. I am requesting your voluntary participation in this research study.

Your opinions and experiences are very important in this study, and you need to give an accurate picture, to enable me as the researcher to be able to analyze the current food safety practices in public hospitals in particular.

The main objective of the study is to:

- Investigate the food safety Knowledge and hygiene practices of food handlers
- Verify if in-house food services implement food safety measures (HACCP)
- Evaluate the availability and adequacy of food service facilities
- Evaluate the microbial quality of equipment and food service surfaces

The health institution will benefit, because if problems compromising food safety in food service units are identified, they could be addressed to improve the current situation.

Participation in this study is voluntary. You can withdraw from the study at any stage if you do not feel like continuing, even after you have consented to participate in the study. Please feel free to express your opinions and your experiences when completing the items put forward in the questionnaire. Your honest input is needed. Anonymity will be maintained and all the information given by you will be managed with strict confidentially.

Please do not write your name on the questionnaire, or anything that can identify yourself in any way. Nobody, except me as the researcher and a statistician, will see your questionnaire

once it has been completed. It should take you approximately thirty to forty five (30-45) minutes to complete the enclosed questionnaire. For any enquiries, please find my contact numbers on the outer cover.

Please place the questionnaire in the envelope provided, and seal the envelope before handing it in to your food service manager.

Thank you very much for your cooperation and assistance in this regard.

Researcher's signature_____

Date_____

This page is to be retained by participant

Appendix 3: Consent to participate in research study

LETTER OF CONSENT TO PARTICIPATE

CONSENT

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the research study project at any time, should I so desire.

……

..... SIGNATURE OF PARTICIPANT

DATE

This page is to be retained by researcher

Appendix 4: Permission letter to conduct research

LETTER SEEKING CONSENT TO CONDUCT RESEARCH FROM THE DEPARTMENT OF HEALTH LIMPOPO PROVINCE

48 Paragon Street

Ivy Park Extension 34

POLOKWANE

0699

Head of Department

Department of Health and Welfare

Limpopo Province

POLOKWANE

0700

Re: Application to conduct a research study

I am currently studying for the Masters of Consumer Sciences Degree with the University of South Africa; and I am expected to conduct a research study as a requirement for the degree. This qualification is a research-based degree and research is a pre-requisite exit point.

May I therefore, request your permission to conduct this study in Capricorn District Municipality?

The topic for my research is: "*Food safety knowledge, attitudes and food handling practices of food service employees in hospitals"*.

This is both a qualitative and quantitative, descriptive study as it involves the use of observations, interviews and structured questionnaires to collect data to analyze food safety knowledge and food handlers' practices in hospitals identified.

You cooperation will highly be appreciated in this regard.

Thanking you in anticipation.

Yours truly,

Lesiba Augustine Teffo (Researcher)

Appendix 5: Proposal approval letter from University of South Africa

UNISA university of south africa

2015-12-04

Ref. Nr.: 2015/DLCS/002

To :
Mr L Teffo
Student nr: **57667764**
Department of Life and Consumer Sciences,
College of Agriculture and Environmental Sciences
Unisa

Cc: Dr F Tabit
Supervisor

Dear Mr Teffo

Request for approval of the Masters in Consumer Sciences research proposal submitted:

Food safety knowledge, attitude and food handling practices of food service employees in hospitals in the Capricorn District Municipality in Polokwane, South Africa

The research proposal "Food safety knowledge, attitude and food handling practices of food service employees in hospitals in the Capricorn District Municipality in Polokwane, South Africa" was reviewed by two independent reviewers. The proposal has been approved (81%). The approval of the research proposal allows you to continue and register for the dissertation phase of your Masters in Consumer Sciences in 2016.

You are hereby requested to complete the necessary CAES Ethics application forms and submit the electronic application to the Post Graduate Officer, Ms Marthie Van Wyk at vwykmj@unisa.ac.za for Ethics clearance.

Wishing you all the best with the research you are undertaking.

Kind regards,

Lebelo.

Dr SL Lebelo
Chair: Departmental Research Committee
Department of Life and Consumer Sciences
Unisa

Open Rubric

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 429 12 429 4150
www.unisa.ac.za

Appendix 6: Ethics letter from UNISA's College of Agriculture and Environmental Science

UNISA university of south africa

CAES RESEARCH ETHICS REVIEW COMMITTEE

Date: 17/02/2016

Ref #: **2016/CAES/025**
Name of applicant: **Mr LA Teffo**
Student #: **57667764**

Dear Mr Teffo,

Decision: Ethics Approval

Proposal: Food safety knowledge, attitude and food handling practices of food service employees in hospitals in the Capricorn District municipality in Polokwane, South Africa

Supervisor: DR FT Tabit

Qualification: Postgraduate degree

Thank you for the application for research ethics clearance by the CAES Research Ethics Review Committee for the above mentioned research. Final approval is granted for the duration of the project, **subject to submission of permission from the Limpopo Department of Health**.

Please note points 4, 5 and 6 below for further action.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the CAES Research Ethics Review Committee on 17 February 2016.

The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the CAES Research Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*
4) *The Committee acknowledges the Limpopo Department of Health's stipulation that ethics clearance must first be obtained from Unisa before they will give permission for the project. Ethics clearance is hereby provided, but data collection may not start before the permission letter from the Limpopo Department of Health has been obtained and submitted to the Committee.*
5) *The application does not identify the laboratory to be used and this must be clarified. If it is not the Unisa laboratories a permission letter must also be obtained from the relevant institution and submitted to the Committee.*
6) *Provide an explanation of the procedure to be followed during the taking of swabs. Where will the swabs be taken? How many will be taken? Also describe the analysis of the swabs.*

Note:
The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the CAES RERC.

Kind regards,

Signature
CAES RERC Chair: Prof EL Kempen

Signature MJ Linington 18 Apr 16
CAES Executive Dean: Prof MJ Linington

NB : Points for further action.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
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Appendix 7: Permission letter from Limpopo Department of Health

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

Enquiries: Latif Shamila

Ref:4/2/2

Teffo L
UNISA
P.O.Box 392
UNISA
0003

Greetings,

RE: Food safety knowledge, attitude and food handling practices of food service employees in hospitals in the Capricorn District Municipality in Polokwane, South Africa

The above matter refers.

1. Permission to conduct the above mentioned study is hereby granted.
2. Kindly be informed that:-
   - Research must be loaded on the NHRD site (http://nhrd.hst.org.za) by the researcher.
   - Further arrangement should be made with the targeted institutions, after consultation with the District Executive Manager.
   - In the course of your study there should be no action that disrupts the services.
   - After completion of the study, it is mandatory that the findings should be submitted to the Department to serve as a resource.
   - The researcher should be prepared to assist in the interpretation and implementation of the study recommendation where possible.
   - The above approval is valid for a 3 year period.
   - If the proposal has been amended, a new approval should be sought from the Department of Health.
   - Kindly note, that the Department can withdraw the approval at any time.

Your cooperation will be highly appreciated.

Head of Department

14/03/2016
Date

18 College Street, Polokwane, 0700, Private Bag x9302, POLOKWANE, 0700
Tel: (015) 293 6000, Fax: (015) 293 6211/20 Website: http/www.limpopo.gov.za

Appendix 8: Consent Letter to Limpopo Department of Health

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF HEALTH

Enquiries: Latif Shamila Ref:4/2/2

CONSENT LETTER :

Name of Researcher :	Lesiba Augustine Teffo
Telephone Numbers :	072 269 3656 or 011 471 3077
E- Mail Address:	lteffo@vodamail.co.za / teffola@unisa.ac.za
Institution:	University of South Africa - UNISA
Approximate Date of targeted completion of the study :	31 March 2017

I Lesiba Augustine Teffo (Full Name of Researcher) hereby confirm that I have requested permission to conduct a study at the Department of Health in Limpopo- South Africa.

I commit to submit my completed study including all my findings and recommendations to the Provincial Health Research Committee, within three months of completion. I will assist the Department in the interpretation of the findings if needed. Kindly submit the documents in HARD and SOFT copy.

I consent that my findings can be used for the benefit of the Department.

LESIBA
Name of Researcher

Sign

15/03/2016
Date

18 College Street, Polokwane, 0700, Private Bag x9302, POLOLKWANE, 0700
Tel: (015) 293 6000, Fax: (015) 293 6211/20 Website: http/www.limpopo.gov.za